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The Welsh Engineers' and Founders' Association
The Foundry Trades' Equipment and Supplies Association

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A Mollycoddled Metal

When a metallurgist of international repute finds it amusing to write a brief article of the type of "An Open Letter to Aluminium, by Cast Iron," published elsewhere in this issue, it is worth examining what has been the urge. Ferrous metallurgical practice, as it exists to-day, largely developed from a craft into something of a science, whilst still retaining its craftsmanship. The light alloys, on the other hand, were predominantly the discovery of research workers, and it was not long before the technical literature attained the proportions of the very much older ferrous branch of metallurgy. This condition has led to the postulation of theoretical limits prior to their discovery in practice, whilst for steel the reverse has usually been the case

As a consequence, with the latter there has been a general tightening-up of specifications with the passage of time. In the field of the light alloys a growing body of practical people believe that progress would best be achieved by some relaxation in the various specifications. When specifications are too severe, there is always a temptation to resort to malpractices for their fulfilment. At one period in metallurgical history, too much importance was attached to the attainment of high maximum stress in steel, and measures conducive to brittleness were often taken in order to satisfy the then current specifications. To-day, such requirements are met by the use of alloyed material.

The weak point in the armoury of the average high-grade research worker is his complete disregard of the effect of mass, and no doubt it is this factor which "Cast Iron" has in mind when he writes sarcastically of the "$\pm$ 2 deg. C." The practical man, well knowing the theoretical range, still uses his discretion as to heat-treating temperatures based on time and mass, and on subsequent processing and uses. The lowering of the minimum requirements demanded by a specification does not usually result in the production of inferior material, for it is common knowledge that intense pride is universally taken in "beating" the figures postulated by large margins. Moreover, granted that a specification becomes too easy of fulfilment, there quickly arises a body of opinion in favour of revision. Mr. J. Deschamp's campaign in the years prior to the war for "stiffer" specifications for steel castings is still fresh in our memories.

We do not suggest that the most exacting specifications for light alloys should be made easier, but that an effort should be made to place more types of castings—service conditions permitting—into a category for which the acceptance conditions can be met by the average non-specialist foundry. The encouragement that this would give would soon have its own reward, and practice, under happier conditions, would result in a constantly improving performance. Inspection would soon reveal which foundries were making sufficient progress to tackle castings entering into the most stringent categories.

We have every sympathy with the Service Departments, for a "dud" piece of armament can render a crucial effort abortive. What we do recommend, however, is a modicum of elasticity in specificational requirements of light alloys, where this can be done with safety. Whilst quality is essential, quantity is not without importance, and certainly the latter factor would gain by the adoption of less severe conditions wherever possible.

In making adjustments to specifications, we ask the authorities to bear in mind that aluminium is much more robust than is generally thought to be the case. It is not only to acceptance specifications that we refer, but also to the conditions imposed during manufacture, where the required tolerances are often of too narrow a magnitude. The provision of wider margins would not only accelerate production, but would help to place the light alloys in their proper category of normal engineering materials, and not exotic hot-house products.

We wish our readers a peaceful Christmas and a New Year bringing victory to our arms.

An Open Letter to Aluminium

BY CAST IRON.

If ever there were a snob, it is you, Aluminium. We all know what you have done for aviation, but why swank about it? You were born light and I was born heavy, but neither of us had anything to do with that. I do not know what has spoiled you, but am inclined to think the trouble is all due to your friends. They have talked so much about thermal-equilibrium diagrams, structure and precipitation-hardening, that it is not surprising that, young as you are, you now think that, without you, there would be no equilibrium diagrams, no structures and no precipitation-hardening.

And then, the way you are treated, or think you are treated. Nothing but ± 2 deg. C. for Mr. Aluminium!

But what about your melting point, Mr. Aluminium? I have an idea that, if you had not had such a low melting point that you can be melted by a schoolboy in a glorified cooking oven, you would not have received anything like such attention. And this precipitation business: other people precipitate besides you.

If anything makes me laugh, it is to hear you talk about your ± 2 deg. C. electric super-circulating air furnaces. You humbug, you can stand as much as the next man, and just you own up. I have seen you fall out of the furnace when the door went up, be chased all around the floor before you were caught, and even then you "worked," and "worked" well.

I have also heard some funny stories about ± 2 deg. C.

CAST IRON.

P.S.—You are worse than that fellow Tungsten ever was.

Institute of British Foundrymen

HOLDING OF ANNUAL GENERAL MEETINGS DURING THE WAR

At the meeting of the Council of the Institute of British Foundrymen held in Birmingham in October, it was decided that the Institute should seek powers to dispense with the necessity for holding annual general meetings during the period of the present war. The necessary steps were taken, and we now learn that the Lord President of the Privy Council, in exercise of the powers conferred upon him by the Chartered and Other Bodies (Temporary Provisions) Act, 1939, and the Order in Council made thereunder, has been pleased to direct that for the period during which the above-mentioned Act remains in force, and notwithstanding anything in the Charter and Bye-Laws of the Institute of British Foundrymen, the following provisions shall have effect:—

(1) It shall not be necessary to hold an annual general meeting of the Institute unless such a meeting is demanded by a requisition signed by at least twenty members, provided that in every year in which an annual general meeting is not held the general report, statement of accounts and balance-sheet shall be forwarded by pre-paid post to every member of the Institute entitled to attend annual general meetings.

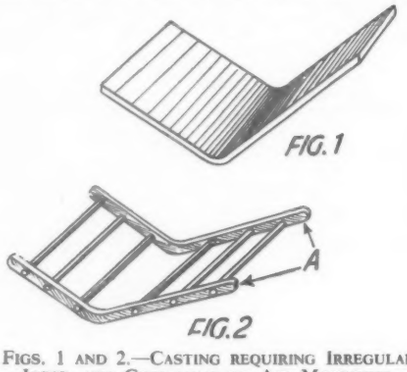
(2) Unless a requisition as aforesaid shall have been made, the provision of the Charter and of Bye-Laws 12, 13, 14 and 16, so far as they relate to the election of officers, shall remain in abeyance and the officers named in

(*Continued in next column.*)

Some Jobbing Foundry Experiences—XIV

By "TRAMP"

Jobbing foundries cannot afford to make and store special moulding boxes for occasional orders, and consequently they have to utilise the most suitable boxes available together with various expedients, when these particular jobs are ordered. Fig. 1 illustrates such a case. It shows a casting necessitating an irregular joint and consequently a deep top "lift," as the job is cast in the position shown, the bottom being bedded down into a bottom box. For repetition work a top box with bars cast to the contour of the job would be ideal, but as the demand for these castings is small a plain top is used. Difficulty being experienced in getting good clean "lifts" by "staying" prompted the making of a grid, as sketched in Fig. 2. This consisted of two pieces of wrought iron, A, bent to the shape as shown, and six bars riveted in position. This structure, being secured to a shallow top box, gave every satisfaction. The construction of this grid as described was adopted because of the comparative ease of manufacture over a cast-iron grid, which would have had to be made in two pieces and secured together, or else made from a pattern in a two-part moulding box, an expense not justified by the demands for the castings under consideration.



FIGS. 1 AND 2.—CASTING REQUIRING IRREGULAR JOINT, AND GRID MADE TO AID MOULDING.

London Foundrymen's Christmas Luncheon

The London Branch of the Institute of British Foundrymen has arranged for the holding of a Christmas luncheon at the Constitutional Club, Northumberland Avenue, London, W.C.2, at 12.45 p.m. for 1.15 p.m. on Saturday, December 21. The cost of the luncheon is 5s. per person excluding refreshments, and members may invite guests if they so desire. The management committee of the Constitutional Club has kindly offered honorary membership for the day to all those who attend the luncheon.

(*Continued from previous column.*)

the first paragraph of Bye-Law 12 shall be entitled to retain their respective offices until the next annual general meeting.

In view of the above direction of the Lord President of the Privy Council, the Executive Committee of the Institute has resolved that no annual general meeting will be held during 1940, and that a decision with regard to the holding of future annual general meetings covered by the direction of the Lord President of the Council will be made subsequently by the Council of the Institute.

Random Shots

A certain foundry owner who lives in the country is getting rather worried because he hasn't yet received permission from the Ministry of Food to kill a pig for Christmas. It is rumoured that the Ministry of Food would have nothing to do with the request, and that it was passed on to the Iron and Steel Control with the usual query, "Is this yours?" It is felt, however, that after going the rounds of the many Government departments in its neat little folder, it will eventually get back to the Ministry of Food in time for them to O.K. the request for next Christmas.

* * *

Difficulty is being experienced in one London suburb in getting sufficient dogs' meat . . . and even the cats are finding out to their chagrin that people are concealing their lights.

* * *

This Changing World

In the piping days of peace when innumerable aunts asked innumerable little nephews "What do you want to be when you grow up?" they could always depend on receiving the standard answer "An engine driver." One little lad the other day, however, surprised his aunt by greeting the time-honoured question with the blunt but forceful answer "Alive, of course."

* * *

"Life must have metals" was the heading of a recent popular-science article. Perhaps that explains why the maid, when her mistress was suddenly taken ill one day, said "Shall I run next door and fetch Dr. Hurst?"

* * *

Another schoolboy howler . . .

A spatula is one of those half-man, half-woman animals you read of in Greek mythology . . . half a spinster and half a bachelor.

* * *

Commercial travellers on the western circuit please note . . . *advertisement in local paper.* For sale: Fully liced hotel. S.A.V. West Country town.

* * *

More dangers of abbreviation .

Seen in a stamp approval book.—The Spanish stamp of the "Goya" series, with the inscription underneath "Used cat 1s. 9d."

* * *

"Oh aye, we did things in grand style in them days," said Mrs. Malaprop, reminiscently. "Why, me and my 'Arry even went pulmonary to Brighton one 'oliday."

* * *

The week's best crossword clue comes from "The Daily Telegraph."

Clue—A King is never called this during his reign.

Answer—First.

MARKSMAN.

The "Stantonian"

Firms and individuals interested in social welfare might with advantage study the current issue of the "Stantonian," the magazine of the Stanton Ironworks Company, Limited, near Nottingham. What is particularly interesting is the study of industrial accidents as investigated by the various safety-first committees. It should be remembered that Stanton is a very large-scale enterprise which has devoted considerable attention to such matters, and as a result it has learnt many lessons from which other concerns can profit. Practical foundrymen will also appreciate the short article dealing with the manufacture of Dale pig-iron.

Efficient Trichlorethylene Degreasing*

By E. E. HALLS

The use of trichlorethylene in solvent degreasing plants is due to several meritorious characteristics. One of the most important of these is the fact that the material, being heavily chlorinated, is non-inflammable. In a general sense it is a stable chemical, although this statement requires slight qualification in certain instances. It is a heavy liquid boiling at 87 deg. C., and the vapour is dense so that the material can readily be controlled in steam-heated plants designed structurally so that the vapour can be lifted or lowered at will. It is practically immiscible with water, but is a good solvent for mineral and vegetable oils, waxes and many grease-like materials.

From the operator's health point of view the vapours of trichlorethylene are not potently toxic, but are objectionable and can be dangerous under certain conditions. Consequently, it is essential in all plants to design, install and operate in such a manner that the possibility of workers being in continual contact with the fumes is an impossibility.

Types of Plant

Many types of degreasing plant are available, according to the class of work upon which they are to be employed. In general, however, they may be regarded as being in one of three categories—that is, vapour, liquid, or combined liquor and vapour type degreasers. They may be manually operated, or semi-automatic or automatic. It is also possible to arrange for rotary barrels of the fixed or travelling varieties.

In the case of vapour plants, these essentially consist of liquid trichlorethylene contained in a sump at the lower portion of the equipment, the sump being capable of heating by steam coil, gas or electricity. In this way vapour is raised into the plant. It is prevented from passing through the outlet at the top of the plant by suitably positioned cold water coils, while it can be completely condensed and brought down again by cooling coils arranged just above the sump.

In this type of equipment degreasing is dependent upon cold work entering the vapour with resultant condensation upon the work. This condensation is rapid and causes the work to be washed down and thereby degreased. However, in this process only soluble constituents are removed, and very little solid dirt, swarf or other contamination is removed.

In the liquid plants work is immersed actually in the liquid trichlorethylene, and in most cases two or three sumps of the liquor are contained in the same equipment. These reservoirs are arranged weir fashion, and the work is passed successively up the weir. Vapour condensation from the top cooling coils is led by means of a gulley to the top weir, which is thereby always replenished by clean solvent. An overflow from the top weir passes to the second and then to the third, so that it is ensured that work leaving the degreaser is thoroughly cleansed from both oil, grease and loose solid.

In a combination of the two types of plant the work is first rinsed in the liquid reservoir of hot trichlorethylene and then passed to the vapour section for a final vapour swill. The condensate from the vapour section then passes back to the liquid compartment. However, due to the fact that a vapour degreaser only reaches maximum efficiency if cold work is introduced into it, the modern practice is to use a three-section plant through which work is passed in order through hot liquid, cold liquid and finally vapour.

* From an article in "Metal Treatment."

The rate of dissolution of oil in trichlorethylene is rapid. The actual speed of operating will depend upon the mass of metal introduced for cleaning, and although a steam pressure of the order of 30 lbs. per sq. in. gives quite satisfactory operation, and is considered to be the maximum safe pressure with regard to the temperature of the trichlorethylene, many plants operate as high as 90 lbs. steam without undue trouble. These higher steam pressures are purposefully chosen to provide rapidly the heat required for heavy loads.

The theory is that if trichlorethylene is overheated it does decompose to a slight extent, producing acidity which causes corrosion of the plant and failure at weak points. This has only been seriously reported in practice where the main contamination of work has been soluble cutting oil containing much water. It is agreed, however, that in the gas-heated or electrically-heated units, greater care in design has to be taken owing to the larger possibility of local overheating, and for this reason alone steam should be utilised wherever practicable in industrial degreasers.

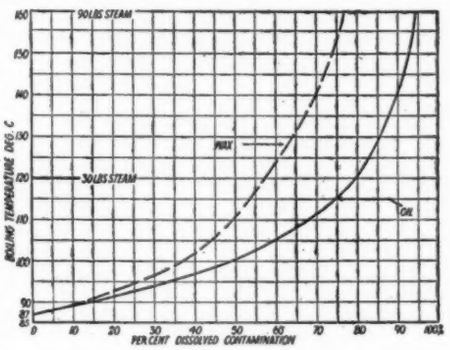


FIG. 1.—ELEVATION OF BOILING POINT OF TRICHLORETHYLENE WITH INCREASING CONTAMINATION.

Recovery of Solvent

In most modern plants all recovery of solvent is achieved within the plant, vaporising it in the heated sump, condensing it by means of the upper cooling coils, thence collecting it in gulley channels which normally return it to the sump. When time for cleaning the equipment arrives, distillation is effected inside the plant with the gulley tapped to an outside channel provided with a suitable receiver. Older plants, and some present large installations, are provided with an auxiliary external still. This is considered an essential with all except the smallest equipment. The point is that dissolved oil rapidly raises the boiling point of the liquid so that the normal heating arrangements of the plant fail to recover solvent from the contaminated liquor beyond a certain point. This particularly applies to plants of restricted heat capacity, that is, gas or electric heating, or low pressure steam. If, however, an external heating arrangement is provided, this can be fitted with a greater source of heat to produce the necessary higher boiling temperature, and any slight effect of decomposition can be confined to the small additional equipment.

In this connection, the curves shown in Fig. 1 are of interest. One shows average values for the elevation of boiling temperature by increasing contamination with wax such as the beeswaxes employed for spinning. The other shows the average influence of light oils such as sulphurised cutting coolants or mineral blanking lubricants.

TABLE I.—*Characteristics of Commercial Trichlorethylenes of Different Origins.*

	Material A (unstabilised material)	Stabilised materials. Material B, Source 1.	Material C, Source 2.
Boiling point, deg. C. ..	87	90 per cent. 87 to 90, 10 per cent. above 90	87
Non-volatile residue, per cent.	0.0010	0.0020	0.0050
Specific gravity at 15.5 deg. C...	1.470	1.460	1.465
Reaction	Faintly acid	Slightly alkaline	Neutral
Acidity, expressed as hydrochloric acid, per cent.	0.0004	—	—
Alkalinity, expressed as ammonia, per cent. ..	—	0.0034	—

Quality of the Solvent

Regarding the quality of trichlorethylene, there are ordinarily two commercial qualities available, namely, the normal material and the one described as stabilised. The reason for this is that in the presence of light or of traces of moisture or a combination of the two, the liquid decomposes to a very small degree with the formation of hydrochloric acid. This decomposition is suppressed and entirely negatived by the stabilising treatment. It is, therefore, the

(*Continued on page* 394.)

TABLE II.—*Stability of Trichlorethylene. Extent of Decomposition under Exposure Conditions of Dryness or Wetness Light or Darkness.*

(Acidities expressed in terms of hydrochloric acid, alkalinities as ammonia.)

Conditions of exposure.	Period of test. Days.	Per cent. from neutral. Material A. Acidity.	Material A. Alkalinity.	Material B. Acidity.	Material B. Alkalinity.	Material C. Acidity.	Material C. Alkalinity.
Normal light, dry	0	0.0004	—	—	0.0040	—	—
	10	0.0010	—	—	0.0030	—	—
	30	0.0020	—	—	0.0030	—	—
	100	0.0050	—	—	0.0030	nil	nil
Normal light, wet	0	0.0004	—	—	0.0040	nil	nil
	10	0.05	—	—	0.0020	nil	—
	30	0.20	—	—	0.0015	0.0005	—
	100	0.50	—	nil	nil	0.0008	—
Darkness, dry	0	0.0004	—	—	0.0040	nil	nil
	10	0.0005	—	—	0.0040	nil	—
	30	0.0010	—	—	0.0030	nil	—
	100	0.0040	—	—	0.0030	nil	—
Darkness, wet	0	0.0004	—	—	0.0040	nil	nil
	10	0.02	—	—	0.0030	nil	—
	30	0.00	—	—	0.0020	nil	—
	100	0.30	—	—	0.0010	0.0005	—

Labour Recruitment and Good Housekeeping

MR. N. C. BLYTHE'S PRESIDENTIAL ADDRESS IN BIRMINGHAM

The Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen is endeavouring to respond to the appeal of the National President (Mr. W. B. Lake, J.P.) to "carry on." Unfortunately, the opening meeting of the new session, due on October 18, had to be cancelled, but on November 23 members of the Branch met in Birmingham. Following Mr. N. C. Blythe's Presidential Address, Mr. J. L. Francis, of Ipswich, presented a Paper, illustrated with an instructive series of lantern slides, on "The Production of Pressure-Resisting and High-Duty Iron Castings." This Paper, which has already appeared in the JOURNAL,* was prepared for the Cheltenham Conference which had to be cancelled owing to the war.

In opening the meeting, MR. BLYTHE thanked all present for attending. He recalled that the Branch planned to meet in October, but conditions arose which called for a quick decision. He took the full responsibility for the decision to cancel that meeting, and apologised to those few members who made a needless journey because it was impossible to notify them. Profiting by that experience, they decided to hold a Saturday afternoon meeting. Their duty seemed to be so to order their affairs that the best service was rendered to the nation irrespective of all other considerations. If, in so doing, they could at the same time maintain contact and useful work within the Institute, they would be contributing to the greater usefulness which it would fulfil in the days of peace which were to come.

* See our issues of June 20 and 27 and July 4, 1940.

PRESIDENTIAL ADDRESS

The need for an improved type of recruit in the industry and cleanliness in the foundry were the main topics of Mr. Blythe's Presidential Address. So far as the former went, the recruiting of personnel, especially when it meant the selection of recruits, might be good in theory, but was bad in practice at the present time. All were learning to appreciate the finer distinctions in the various jobs which had to be done, and the grading of them according to the degree of skill required for their execution. That was the preliminary step to dilution, or the process of using skilled men for skilled work, leaving the simpler types of work for less skilful hands.

Having achieved that separation, the proper use of machinery for moving, lifting and carrying to the greatest degree must be a policy with which no one could disagree. In an industry run on such prodigality of effort the introduction of machinery for the conservation of that effort was inevitable. Indeed, it was imperative. Although that might seem to be an obvious truth, yet there were still many who saw cause for congratulation in the fact that they could operate with a low proportion of wages other than that of moulders, and not have any machinery at all. The necessities of to-day would tend to eliminate such inefficiency, and they should profit by the lesson. Foundries would still be making castings for a long time after the war was won, and a point of view of foundry organisation would develop which, if continued, should ensure the attraction to the industry of a better type of recruit. Most of them agreed that the foundry did not attract the best personnel and that better personnel was required; but what would prove to be attractions in the years ahead must be made now.

Improved Conditions Sought

Ever since he had worked in a foundry he had been impressed by the toleration which existed towards uncleanliness and untidiness. While it was agreed that cleanliness was especially difficult in a foundry, there did not seem to be any good reason why it should be untidy. Yet it was often so. It was not because foundries could not afford amenities which meant cleanliness and tidiness, because there were clean and tidy foundries, and the people employed therein were no doubt better satisfied in consequence. Included in his ideas for a better foundry were inside walls built of white glazed bricks which could be kept clean and white by frequent automatic washings.

It might be that the toleration towards uncleanliness was one of the reasons why foundry work was inefficient measured in terms of output per man-muscle power. He believed that it was. Certainly the greatest problem of anyone putting machinery into a foundry was to obtain some guarantee that it would be kept clean. The best machinery in the world would not give service when half-buried in a heap of sand. A great deal of good equipment had been condemned and thrown out of foundries because it was expected so to function.

Vote of Thanks

Proposing a hearty vote of thanks to Mr. Blythe for taking office, and also for his inspiring address, MR. F. J. COOK (Past-President of the Institute) remarked that there was very little to criticise in the latter and much to discuss. The President had spoken of friendships made in that Branch. He was prepared to say that he had made more friendships in the Institute of British Foundrymen than in any other kindred association. He had been connected with many other associations, national and local, and he had never made so many sustained friendships with men he admired as he had in the Institute. Having been associated with the foundry for more than seventy years, he could say that a better class of personnel was entering the foundry to-day than had ever been attracted to it before. More men were needed at the top of the tree in the foundries than in any other branch of engineering. Mr. Blythe had given them his views about cleanliness and his ideal foundry. He (Mr. Cook) happened to be connected with a foundry in which cleanliness was one of the main objects, and some of them might be surprised

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Efficient Trichlorethylene Degreasing

(*Continued from page* 393.)

stabilised variety that should be employed in degreasing processes.

Data appertaining to these commercial trichlorethylenes are given in Tables I and II. Table I gives the physical and chemical characteristics of an unstabilised material and of stabilised materials of two different varieties. The unstabilised material A is not normally employed for degreasing purposes owing to its slight initial acidity and its relatively rapid development of acidity under conditions of light and moisture. Both the stabilised varieties are satisfactory, and preference is generally given to material of type B because, initially faintly alkaline, it never turns acid under normal conditions.

Table II gives typical data showing stability of these trichlorethylenes under different conditions of light and moisture. The samples concerned were all redistilled dry products, and the tests under wet conditions were carried out by adding 10 per cent. of pure distilled water to the sample. The samples were exposed in normal laboratory light or in closed cupboards with an occasional shaking. They were tested at periods for acidity, for which purpose sufficient separate test samples were initially exposed.

It will be seen from the test results that the ordinary trichlorethylene tends to increase in acidity under all conditions, but only to attain serious acidity when exposed to light, whether wet or dry. The stabilised material of type B failed to develop acidity under any circumstances, although its initial alkalinity decreased; thus, even under combined conditions of wetness and light, the material remained neutral. Material C, which was virtually neutral initially, showed acid development only under damp conditions, and even then the extent of acidity was virtually negligible.

Prevention of Loss

The vapour pressure of trichlorethylene at ordinary temperatures (20 deg.) is 64 mm., which is one-twelfth of an atmosphere. This is relatively high, and represents a serious potential loss of solvent as well as a possible inconvenience to operatives. Manually-operated plants are fed from the top, and displacement upon entry or withdrawal of work leads of necessity to some vapour loss, which can be minimised by avoiding turbulence and undue draught. Continuous automatic plants must be provided with efficient cold seals to reduce the vapour pressure at outlet and inlet to a minimum and attention in design must be given to eliminate the promotion of anything in the nature of a through-draft which can cause a continual vapour loss. At the same time the location must be discreetly ventilated.

Another direction in which losses occur must not be overlooked, and this concerns the handling and disposition of work. Liquid can easily be carried out of degreasing plants in articles having anything in the nature of a cup. Small shells, pots and suchlike articles should be relegated to rotary barrel plants in order to ensure emptying them before withdrawing. Vapour can similarly be withdrawn unnecessarily, and may even be carried out by virtue of its density by incorrectly packed sheet or formed work. For inexpensive operating, excessive attention cannot be given to the question of packing.

The above comprise a few random facts on trichlorethylene solvent degreasing processes. They apply to all modern machine shops which take advantage of up-to-date production methods as well as to the precleaning sections of electroplating and enamelling departments. For efficient operating, that is lowest running costs, good cleaning and high production rates, the following are the criteria to be fulfilled:—(1) Choose the best stabilised solvent. (2) Give attention to design of plant with respect to mode of heating, recovery of solvent, escape of vapour, adequacy of cooling. (3) Select vapour or liquor, or both, according to the class of work. (4) Operate the plant fully loaded so that inevitable solvent losses are associated with maximum work. (5) Give intelligent study to mode of packing the work. (6) Remember loss of solvent vapour by undue draught and operating comfort when deciding location. With these points given attention, solvent degreasing can be the cleanest, most rapid, efficient and safest of cleaning operations.

The Acid Bessemer Process of 1940*

By H. W. GRAHAM†

The young metallurgist of to-day who thinks casually of the technical literature of the steel industry might conclude that little has been published concerning the Bessemer process. This conclusion is true as relating to the last decade or two, but there is a fairly voluminous Bessemer literature in the period of 1860 to 1910. Since that time, however, an entirely new level of metallurgical knowledge of steelmaking has been reached; and the present Paper is simply an effort to look broadly from this new level and to bring the recorded history of the process up to date. It is an effort to appraise the acid Bessemer method of steelmaking in the light of to-day's technical knowledge thereof.

Production in the U.S.A.

First of all, it is considered logical and informative to show how much Bessemer steel has been, and is being, produced, and the relation of that production to the tonnage made by the open-hearth process. Table I shows the tonnages made by the two processes in representative years. It is to be noted that these figures are in net tons of 2,000 lbs. Acid open-hearth production and steel going into castings are included, since separated data are not available for the early years of the period covered.

TABLE I.—*Bessemer and Open-hearth Production.*
(Net tons of 2,000 lbs.)

Year.	Bessemer. Tons.	Open hearth. Tons.	Ratio Bessemer to open hearth.
1886	2,541,493	245,250	10.36
1890	4,131,536	574,820	7.19
1895	5,498,223	1,273,644	4.32
1900	7,486,942	3,805,911	1.97
1905	12,254,340	10,047,941	1.22
1910	10,542,305	18,485,050	0.57
1915	9,281,679	26,520,594	0.35
1920	9,949,057	36,592,522	0.27
1925	7,530,837	42,598,627	0.18
1929	7,977,210	54,155,235	0.15
1930	5,639,714	39,255,073	0.14
1932	1,715,925	13,336,210	0.13
1935	3,175,235	34,401,280	0.092
1939	3,358,916	48,409,800	0.070

Figures from records of the American Iron and Steel Institute, which began with the year of 1886.

The ratio shown in Table I is merely the Bessemer tonnage for a given year divided by the open-hearth tonnage of the same year. In 1886 there were 10 times as much Bessemer steel as open-hearth, but in 1939 there was only 0.07 ton of Bessemer steel produced to every ton of open-hearth steel.

TABLE II.—*Production by Decades.*
(Net tons of 2,000 lbs.)

Decade (inclusive).	Open hearth.	Bessemer.	Total.
1890–1899	14,008,805	51,958,415	65,967,220
1900–1909	88,829,931	102,279,180	191,109,111
1910–1919	271,387,204	100,720,580	372,107,784
1920–1929	396,826,453	74,810,357	471,636,810
1930–1939	339,460,846	32,261,865	371,722,711

The ratio constitutes a measure of the demand for Bessemer steel in relation to the demand for open-hearth steel. The uniformity of its trend is striking, and the ratio for the next few years can be predicted with precision. Only new applications for Bessemer steel where open-hearth has been used (or entirely new Bessemer products) will change the trend of this line.

A condensed view of Bessemer and open-hearth tonnage is shown in Table II, giving the production by decades.

Even though production of Bessemer steel has currently dropped back to about one-fourth of its largest figure in 1906, it is still second by a good margin in steelmaking methods. The still important position of the Bessemer process is further indicated by the very considerable tonnage of blown metal made by the Bessemer converter for the open-hearth duplex method, which is reported as open-hearth production. In this connection the tonnages shown in Table III are of interest.

Having viewed figures that show a steady movement to open-hearth production at the expense of Bessemer operation, it will be informative to examine the causes behind this changing relationship.

TABLE III.—*Production by Processes*, 1939.
(Net tons of 2,000 lbs.)

Open-hearth ingots, basic (including duplex)	47,788,763
Bessemer ingots	3,358,916
Open-hearth ingots, acid	437,307
Duplex blown metal (becomes open-hearth ingots)	2,317,382
Total blown in Bessemer converters	5,676,298
Crucible steel	931
Electric and all other	951,522
Total steel ingots	52,537,439

Availability of Scrap

While even the most casual thinker realises that the relationship of Bessemer and open-hearth tonnages is influenced by the availability of steel scrap, few appreciate the extent of the domination of the scrap market upon this relationship, particularly upon the probable future of the Bessemer process.

Initially it would have been difficult for the steel industry to enter rapidly upon a large-tonnage production with any equipment other than a Bessemer converter plant, independent as it is of steel-scrap supply. The Bessemer process uses little scrap, say 5 to 15 per cent. of the metallic charge, where the open hearth uses ordinarily some 50 to 60 per cent. The bloom butts, crop ends, and like scrap incidental to steelworks operation is the same for both processes, say perhaps 15 to 20 per cent. The Bessemer process is more than self-sufficient on scrap and produces a scrap as a by-product. The open hearth constantly uses more scrap than it produces, and this deficit must be supplied by trade scrap originating from previously manufactured steel articles. Only a very small tonnage of steel, and even wrought iron, was manufactured and consumed in the decade or two previous to 1880 and the volume of trade scrap available for steelmaking was insignificant. The introduction of the Bessemer process was therefore very largely responsible for the rapidity with which the industry could advance. In 1886, for instance, the steel production in the United States was 245,250 tons of open-hearth steel and 2,541,493 tons of Bessemer. If it had been necessary to make all of this total production of 2,786,743 tons by the open-hearth process with a 60 per cent. scrap charge, the assembly of such an amount of scrap at that stage of the industry's history would have been a difficult, if not insuperable, problem.

The increase of steel tonnage continued more or less steadily to 1929, and even the Bessemer tonnage increased, or at least held its own, until 1920. With this constantly increasing tonnage more and more scrap was available, to the ultimate disadvantage of the production of Bessemer steel, since such ready availability of scrap obviously favoured the open-hearth process.

Apart from the general effect on the scrap situation of continually increasing tonnage, scrap availability has also been favoured by other factors, among which were those that tended toward more rapid obsolescence of articles made of steel. It is impossible to set very accurately a figure for the useful life of steel products; but in the early history of the industry much of its product went into railway, building and bridge construction, with relatively long life.

The Scrap Position

Later the conditions of the World War created much scrap from steel of very short life. During 1920 to 1930 came large numbers of automobiles with a useful life of some seven years, and a huge increase in the use of tinplate that became scrap in one to three years. But to-day, apart from a few scattered applications, one would expect that the average useful life of a piece of steel will not further decrease, but may even increase, with steady improvement and wider applications of protective coatings.

As long as the total steel tonnage manufactured was increasing, as long as the Bessemer process, with scrap as a by-product well beyond its own small needs, was a large factor in such production, and with the aid of a more rapid obsolescence of fabricated steel products, scrap was bound to become more and more readily available. In the past decade, however, these conditions have changed and an increased supply of scrap can no longer be depended upon. The increase of *per capita* demand for steel has slowed down and any great extension thereof cannot be expected with assurance. Production of Bessemer steel is proportionately so low that its contribution to the supply of scrap is not of great importance. No particular further decrease in the useful life of steel to turn products into scrap in a shorter time can be expected. Therefore it appears that trends in the history of the steel industry favouring an increased availability of scrap have run their course and have become progressively less effective. If correct, these considerations justify earnest attention to an increased use of the Bessemer converter as at least a partial protection against a decreasing availability of scrap.

It is not the intention of this Paper to suggest that the justification for the continuance of the Bessemer process rests upon the fact that it produces more scrap than it consumes. It is merely intended to point out that at present levels the production of Bessemer steel is much too low for a correct balance of processes within the steel industry, and that this factor will continue to exert its economic pressure in the direction of increased Bessemer production.

There may be question as to the justification of discussing steel scrap to this length in a technical Paper, but technologists are too prone to forget that metallurgy and economics are inextricably intertwined. The real purpose of this discussion of scrap is to show the metallurgist that the economic trends of the next decade or two include elements that will favour a revival of converter operation for Bessemer ingots or duplex metal, and only one factor really limits the extent of that revival. That one limitation is the rapidity and completeness with which management, operators and metallurgists can solve such manufacturing and quality problems as are involved. With the present high level of technical knowledge, with improved instrumentation available, and with an economic urge to do the job, there should be rapid progress.

(To be continued.)

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Higher Prices for Scrap Iron and Steel

EFFECT OF INCREASED RAIL CHARGES

A new Order bringing into force new prices for iron and steel scrap came into operation on Monday, December 9. The new rates show only a small increase in prices, the advance in the case of heavy steel scrap being in most instances 6d. per ton. An adjustment in respect of certain special grades of scrap involves larger increases, but the general effect of the new Order is to raise maximum prices sufficiently to meet increased rail charges. A contribution also has been made towards the additional costs which have had to be incurred by merchants, who are now allowed an over-all commission of 3¼ per cent., against 2½ per cent. previously.

The new prices are contained in the Control of Iron and Steel (No. 14) (Scrap) Order, 1940, which supersedes previous Orders. The Order, in its main provisions, follows those laid down in previous Orders controlling the sale of scrap iron and steel. The Direction to the Order makes it clear that sales may not be made unless the purchaser holds a licence granted by the Minister of Supply. Sales of not more than one ton in any one week may be made without a licence, but not to an iron or steel works, foundry or forge, which in all cases and for any quantity require a licence. The maximum prices laid down in the Order may not be exceeded except with the express permission of the Minister of Supply, or when sales are made by bona-fide scrap iron and steel merchants, who may increase the maximum prices by 3¼ per cent.

Foundry Scrap

Table I shows the maximum prices for scrap iron and steel for use for iron and steel foundry castings. The specifications as numbered are:—

1.—Short heavy steel, consisting exclusively of rails, railway tyres and fishplates in cupola sizes not exceeding 2 ft. in length.

2.—Short heavy steel, consisting of shearings, bar ends and constructional scrap not less than ¼ in. thick, in cupola sizes not exceeding 2 ft. in length.

3.—Heavy machinery (including textile machinery) cast-iron scrap, in cupola sizes.

4.—Ordinary heavy cast-iron scrap, not less than ¼ in. thick, in cupola sizes.

5.—Cast-iron railway chairs.

6.—Medium cast-iron scrap, not less than ¼ in. thick in cupola sizes.

7.—Light cast-iron scrap in cupola sizes.

8.—Burnt cast-iron scrap in cupola sizes.

9.—Heavy shovellable steel turnings, free from alloys and non-ferrous metals.

Prices for scrap for use in refined pig-iron making are given in Table II. Prices for scrap hematite-iron ingot moulds and scrap hematite-iron ingot-mould bottom plates, which previously were given in Tables I and II, are now given a separate section in the schedule, the prices applying to all districts. They are:—For the manufacture of steel ingots: (*a*) In furnace sizes exceeding 3 ft. 6 in. by 1 ft. 6 in. by 1 ft. 6 in., £6 1s.; (*b*) in furnace sizes not exceeding 3 ft. 6 in. by 1 ft. 6 in. by 1 ft. 6 in., £6 3s. 6d. For all other purposes, in cupola sizes, in pieces not exceeding 1½ cwts. in weight, £6 11s.

The prices given are based on: (*a*) Scrap being clean; (*b*) deliveries free to consumers' works; and (*c*) the maximum prices may be increased 3¼ per cent. for sales by *bona-fide* scrap iron and steel merchants.

TABLE I.—*Maximum Prices per Ton for Scrap Iron and Steel for Use for Iron and Steel Foundry Castings.* (*For Specifications see above.*)

For use in	1.	2.	3.	4.	5.	6.	7.	8.	9.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Scotland (*see* note below)	82 0	79 6	94 3	89 3	94 3	77 3	72 3	57 9	50 3
Northumberland, Durham and Middlesbrough	82 3	79 9	91 9	89 3	89 3	79 6	74 6	65 0	53 3
Cumberland	82 0	79 6	88 6	83 6	83 6	74 9	69 9	62 6	55 3
Westmorland, Lancs and Wirral Penin.	79 6	77 0	84 6	79 6	79 6	72 3	67 3	58 9	48 3
West and North Ridings of Yorkshire (excluding Middlesbrough)	84 6	82 0	87 0	82 0	82 0	77 3	72 3	62 6	50 9
East Riding of Yorkshire	84 6	82 0	90 6	88 3	89 3	77 3	72 3	62 6	50 9
Derby and Nottingham	84 6	82 0	89 6	87 0	87 0	79 3	74 3	62 6	50 9
Lincoln and Cambridge	84 6	82 0	87 0	84 6	87 0	77 3	72 3	64 0	52 3
Cheshire (excluding Wirral Peninsula)	79 6	77 0	86 6	81 6	81 6	71 9	67 3	57 3	53 3
Anglesey, Caernarvon, Denbigh, Flint, Merioneth, Montgomery and Radnor	77 3	74 9	84 6	79 6	79 6	69 9	65 0	62 6	53 3
Salop, Staffs, Worcester and Warwick	77 3	74 9	92 3	87 6	87 6	80 3	75 3	65 0	46 6
Leicester, Northants, Huntingdon and Rutland	82 0	79 6	89 9	85 0	87 3	75 3	72 3	60 0	51 3
Norfolk	82 0	79 6	87 0	82 0	87 0	72 3	67 6	57 6	51 3
Suffolk	82 0	79 6	88 0	83 0	88 0	74 6	69 9	59 9	51 3
Cardigan, Brecknock, Carmarthen, Pembroke, Glamorgan, Monmouth, Hereford and Gloucester	84 6	82 0	87 0	82 0	87 0	78 3	73 6	62 6	54 3
Somerset, Dorset, Wilts, Hampshire and Sussex	77 3	74 9	87 0	82 0	82 0	72 3	67 6	57 6	46 6
Oxford, Berks and Beds	77 3	74 9	89 3	84 6	84 6	77 3	72 3	62 3	46 6
Essex and Kent	77 3	74 9	87 0	82 3	82 3	73 6	68 6	52 9	46 6
County of London	77 3	74 9	82 3	77 6	77 6	70 3	65 3	52 9	46 6
Middlesex, Surrey, Hertford and Bucks	82 0	79 6	84 9	80 0	80 0	72 9	67 9	52 9	46 6
Cornwall and Devon	77 3	74 9	77 3	72 3	—	62 6	57 9	47 9	—
Northern Ireland	—	—	86 9	82 0	—	69 9	64 9	54 9	—

Notes.—(*a*) Sales c.i.f. ports or wharves on the East Coast of England—the above prices for Northumberland, Durham and Middlesbrough; ports or wharves on the East Coast of Scotland—the above prices for Northumberland, Durham and Middlesbrough, plus 1s. per ton.

(*b*) For cast-iron scrap, specifications 4, 5, 6, 7, 8, 9, arising in Scotland, for use in Scotland the maximum prices shall be :—(*a*) for deliveries free on rail or free on lorry at loading point, the above prices for use in Scotland less (i) 3s. per ton and less, (ii) the excess (if any) of the actual cost of transport to consumers' works over 6s. per ton; (*b*) for deliveries free to consumers' works, the above prices for use in Scotland less 3s. per ton but plus (i) the actual cost of transport to consumers' works or (ii) 6s. per ton, whichever shall be the less.

(*c*) Where delivery of scrap of any one specification under an order of 50 tons and upwards is tendered in quantities not less in the aggregate than 50 tons per three months the above maximum prices may be increased by 2s. 6d. per ton.

TABLE II.—*Maximum Prices per Ton for Scrap Iron and Steel for Use in the Manufacture of Refined Pig-Iron.*

Specifications.	For use in Northumberland, Durham and Yorkshire.	For use in Cumberland and North Lancashire.	For use in North Staffs and Salop.	For use in South Staffs and Worcester.
	s. d.	s. d.	s. d.	s. d.
1.—Short heavy steel scrap, not less than ¼ in. thick	79 9	79 6	74 9	74 9
2.—Heavy machinery (including textile machinery) cast-iron scrap, in cupola sizes	91 9	88 6	92 3	92 3
3.—Ordinary heavy cast-iron scrap, in cupola sizes	89 3	83 6	87 6	87 6
4.—Medium cast-iron scrap, consisting of gas-stove plate, wringers and similar, in cupola sizes	79 6	74 9	—	—
5.—Light cast-iron scrap, including bedstead cast iron, in cupola sizes	74 6	—	—	75 3
6.—Hydraulically-compressed new steel and heavy faggoted steel	71 3	—	—	61 3
7.—Heavy shovellable steel turnings	51 9	52 9	48 0	44 0
8.—Wire rope, in coils or cut lengths, to works' specification	66 3	—	—	—
9.—Cast-iron borings	46 3	51 3	41 3	43 9
10.—Cast-iron borings, not exceeding 0.5 per cent. phosphorus	51 3	—	—	—
11.—Burnt cast-iron scrap and firebars, in handy pieces	65 0	62 6	65 0	65 0
12.—Compressed destructor scrap	48 0	43 0	45 6	40 6

Note.—For deliveries of 50 tons and upwards the maximum prices may be increased by 2s. 6d. per ton.

Supply of Machinery

NECESSITY FOR LICENCES

The Board of Trade call the attention of manufacturers of machinery and plant, and those buying machinery, plant or parts from manufacturers to the fact that the supply of numerous classes of machinery, plant and parts may take place only if the necessary licence is obtained from the Board of Trade. Any person desiring to acquire such machinery, plant or parts must, therefore, first obtain a supply licence, and manufacturers should make sure that the person proposing to acquire the machinery or plant has a licence.

On October 30, a company was convicted of an offence against paragraph 1 of the Machinery and Plant (Control) Order, 1940, for supplying machinery to a person not authorised to acquire such machinery by virtue of a licence granted by the Board of Trade, and was fined £20 and ordered to pay 30 guineas costs.

The relevant Board of Trade requirements are set out in S.R. & O., 1940, Nos. 875 and 1363, which are obtainable from the Stationery Office. The latter Order gives the list of machinery for which licences are necessary. The operation of the Order is further explained in the Board of Trade Journal of August 1 last, which also contains the list of machinery and plant affected. The Orders apply also to second-hand and imported machinery and plant.

Application for licences should be made to the Industrial Supplies Department (Machinery Licences Division), Board of Trade, 25, Southampton Buildings, Chancery Lane, London, W.C.2.

Some Points in Casting Production

By E. LONGDEN, A.M.I.Mech.E.

(*Continued from page* 382.)

Large Cast-Iron Boring Bars

Three cast-iron boring bars were ordered which required castings of the following dimensions and weights:—(1) 15 in. dia. and 43 ft. long, weighing about 10 tons; (2) 18 in. dia. and 45 ft. long, weighing about 15 tons, and (3) 22 in. dia. and 47 ft. long, weighing about 19 tons. The 15-in. and 18-in. dia. bars were cast solid, but the 22-in. bar was lightened by cores. The castings had to be machined all over.

Fig. 1 is a photograph of the 22-in. dia. cored casting, and Fig. 2 the 18-in. solid bar. Fig. 5 shows a cross-sectional view of the cored 22-in. dia. bar. It was decided to make the 18-in. bar first and the 22-in. cored casting the last. No reference will be made about the production of the 15-in. dia. bar, because the difficulties of manufacture are covered by the brief description of the 18-in. solid bar and the detailed description of the 22-in. cored casting.

The problems to be solved are concerned with securing a sound casting in such great lengths. Obviously shorter castings can be safely made by pouring vertically in a similar manner as for hydraulic cylinders and arms. However, to cast a 45-ft. or 47-ft. length vertically, requiring at least a 3-ft. header, which makes a possible length of 50 ft. in a casting, would require most unusual headroom in a foundry, when taking into consideration the use of a pit below the floor line. It would be necessary to have a depth of 66 to 67 ft. from the bottom of the pit to the hook of the crane. If a foundry could be found with the necessary headroom to pour the casting vertically, the great pressure exerted by the molten metal on the bottom end of the mould introduces problems of the resistance of the sand to fusion and metal penetration and also the floating of sullage through such a height into the feeder. However, these difficulties could be overcome if headroom were available.

The bar, therefore, must be poured in the horizontal position with all the well-known difficulties acting against securing such a mass of metal sound in structure and clean from sullage and sand in the upper surface as poured. The ordinary moulding practice would necessitate large headers, each about 100 sq. in., arranged at intervals of about 4 ft. along the top surface of the casting, as shown at B, Fig. 3, and poured with a metal having an analysis of approximately total carbon 3.20, silicon 0.80, phosphorus 0.40, manganese 0.90, and sulphur up to 0.11 per cent. With this combination of headers and metal it would not be possible to avoid unsoundness on the upper face, especially in the region of the headers where open grain and actual cavities might be expected.

Moulding Methods Available

With the many difficulties in mind, the author decided, in view of previous experiments on the influence of mould materials on cast iron, to instruct the foundry to make the casting in a metallised mould which produced remarkably sound castings. Fig. 3 illustrates, generally, three possible methods of producing the lengthy castings. The upper sketch, B, shows the orthodox way of making the casting with headers arranged at intervals of approximately 4 ft. Sketch C shows another method which may be suggested. Sketch A indicates the method adopted by the author which will be explained in detail later. The strickled-loam moulding practice would most likely be the process adopted for the methods B and C, but the mould core method applied as indicated by the sketch A can be employed.

Figs. 4 and 5 give further details of the feeding and gating requirements, Fig. 4 showing the B method, generally described in Fig. 3, and Fig. 5 the gating needs for the A method which was adopted.

The third (C) scheme (see Fig. 3) was not entertained because of the impossibility of securing a satisfactory degree of soundness. It would be impossible to prevent a collection of sullage on the upper surface of the casting, especially adjacent to the ingate entrance, in spite of the inclination of the mould. Further, feeding would be ineffective, since the order of freezing of the metal would be in opposition to the location of the feeding header. The hottest metal would be adjacent to the ingate entrance. Nor would high-temperature metal applied to the feeder head be sufficient to over-

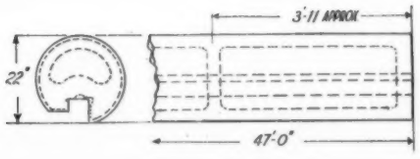

FIG. 1.—CORED BORING BAR, 22 IN. DIA., WEIGHING 19 TONS.

FIG. 2.—SOLID BORING BAR, 18 IN. DIA., WEIGHING 15¼ TONS.

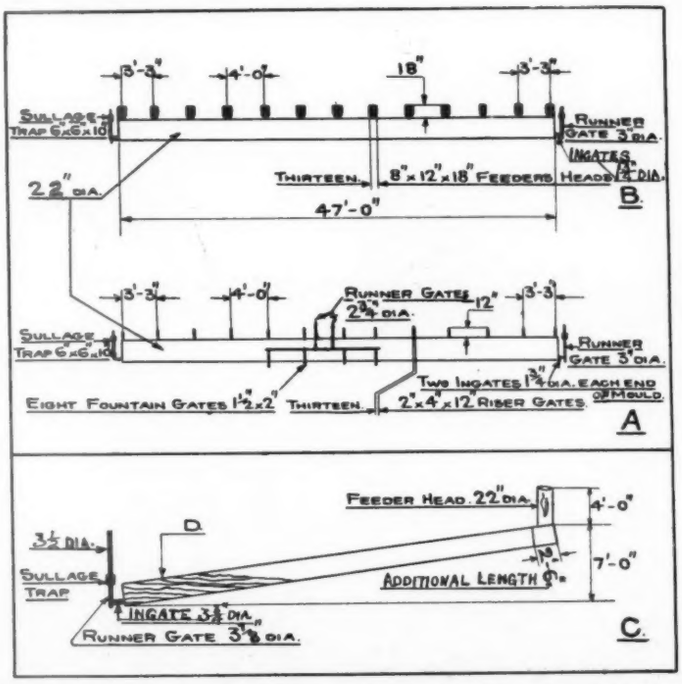

FIG. 3.—THREE POSSIBLE GATING SYSTEMS FOR LONG, HEAVY BARS.

come the heat gradient in the mould and casting.

With any of the methods outlined in Fig. 3 ample machining allowance must be made to eradicate trapped sullage in the top side of the mould and the danger of distortion during cooling, and also errors in moulding. It was decided that an allowance of 1 in. on the top and ½ in. on the bottom was sufficient to cover all contingencies. This made the castings eccentric in shape.

The 18-in. dia. solid-bar casting was chosen as having the greatest amount of liquid shrinkage gate. Fig. 6 shows the effect of dull metal even on very massive sections. A large number of trapped gas holes are visible, and a very large one which communicated from the upper middle area of the casting right through to the riser gate; this blowhole was nearly 2 ft. in length. Fig. 7 illustrates what happened when the casting was poured with metal at a high temperature, between 1,450 and 1,500 deg. C. The cross-section is perfectly solid, in spite of the absence of a feeder head. It was then considered safe to proceed to the construction of the mould as planned. The moulds for the solid F and T. The internal core is kidney-shaped and 2 in. shorter than the external cores forming the mould, which allows for a 2-in. rib between each section of core. Two holes of 4 in. dia. are provided to each core, cutting through the metal section of the casting to enable gases to be passed from the core, and also for securing the core in the middle of the metal section. These holes are plugged before machining. The relative positions of the 4-in. core outlets are shown in C and D, Fig. 8, the actual 4-in. dia. core being shown at D.

With a view to providing a firm resistance

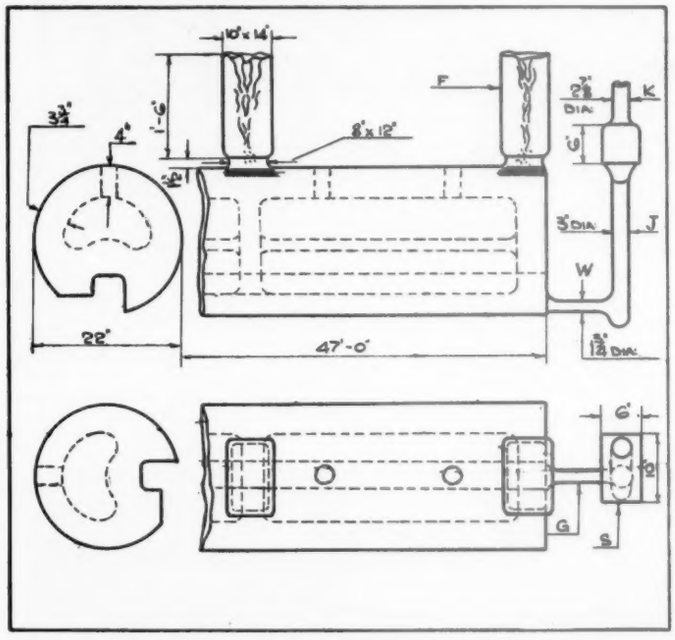

FIG. 4.—FURTHER DETAILS OF GATING SYSTEM.

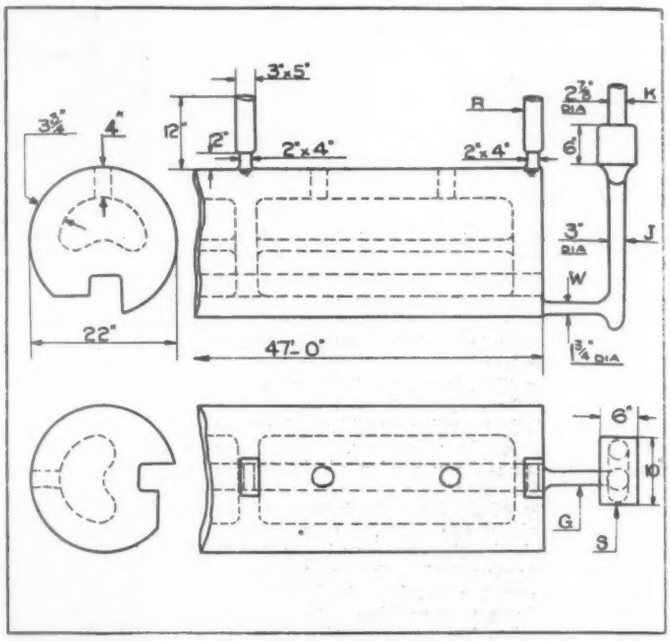

FIG. 5.—CROSS-SECTIONAL VIEW OF THE CORED 22-IN. DIA. BAR.

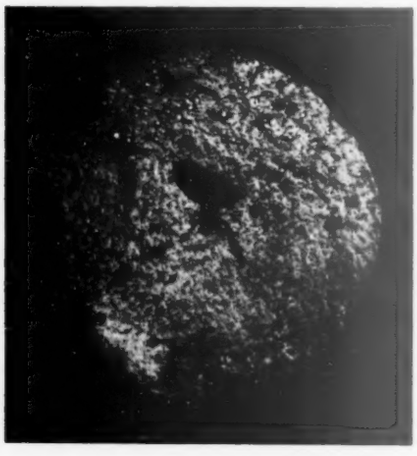

FIG. 6.—EFFECT OF USE OF DULL METAL ON MASSIVE SECTIONS.

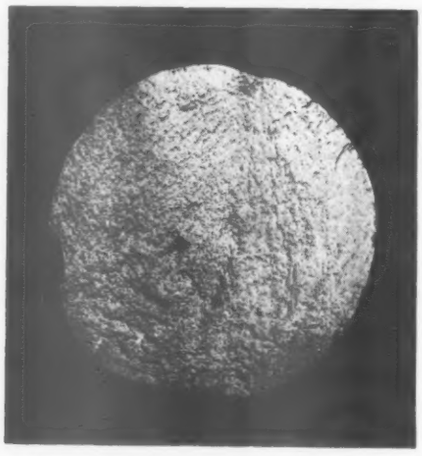

FIG. 7.—CHANGED STRUCTURE DUE TO USE OF HOT METAL.

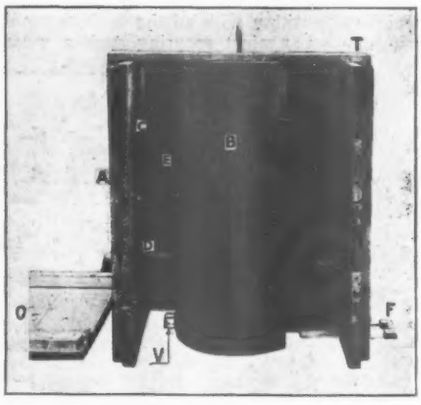

FIG. 8.—SECTIONAL CORE BOX USED.

to overcome, so this casting was made first. The smaller diameter solid and the cored larger casting would not present the same order of difficulty, so far as volume of metal was concerned, compared with the 18-in. solid bar.

Before proceeding to construct the mould for the 18-in. bar, it was decided to pour two experimental short sections of the casting. They were 4 ft. in length and constructed in a similar manner as for the full-length mould. One of the short sections of moulds was deliberately poured with very low-temperature metal which only just passed through the 2-in. by 4-in. riser and cored castings were made in a similar manner, but the larger diameter bar carried lightening cores. A description of the cored bar will suffice for both castings.

A Metal-Faced Mould

The mould was made entirely in cores, the internal face being covered with 2-in. cast-iron blocks as denseners. Fig. 8 shows at A a 4-ft. length of the core box with the front O removed and a segment pattern B conforming to the cross-section of the casting when excluding the core, the position being assured by the locating bars against the pressure exerted when bolting the internal core back to the external core forming the mould, a cast-iron flanged ring E is located on each of the two prints during the ramming of the mould cores. To commence, cast-iron blocks V, approximately 2-in. cube, but with one face radiused to follow the contour of the casting, are located, seated with about ¼ in. layer of thin sieved loam, and wired together around the outer diameter. The whole of the segment pattern B, which forms the outside of the casting, is covered with the 2-in. cube denseners. A plain cast-iron grid, carry-

ing wrought-iron lifting eyes, is next located vertically on the opposite side to the 4-in. core prints, C and D. This grid supports the core during handling when turned down to the horizontal position after drying.

During the ramming of the core three cast-iron rings are placed at intervals and, also, about six vertical ½-in. wrought-iron rods, which reinforce the core generally. The cores were rammed very hard. The sand for the cores, forming the external shape of the casting, was composed of the normal clay-bonded core sand, but with the addition of a little more water than is usually present in such sands. The cores were thoroughly dried at a temperature below 300 deg. C.

Internal Core Construction

Fig. 10 shows at G and W the core box for the internal core H. With a view to facilitating the passage of the core iron J through the 4-in. dia. core holes K, the core iron is notched at intervals to enable easy breaking into small pieces which will pass through the small core

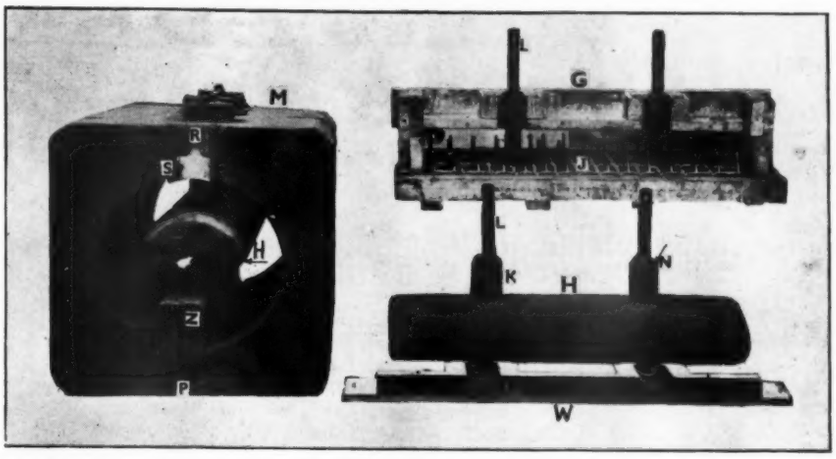

FIG. 9.—ASSEMBLED SECTION OF THE MOULD.

FIG. 10.—INTERNAL CORE AND CORE BOX.

FIG. 11.—ASSEMBLED MOULD AT AN ADVANCED STAGE.

outlets. The tubes L screw into nuts cast in the core iron and serve the purpose of conducting gas away from the core and securing the core in its position. The core is rammed with a core-oil mixture of 4 per cent. good-quality core oil and 96 per cent. large-grain washed silica. A small narrow layer of cinders is located centrally in the core communicating with holes in the vent tubes L. The completed and blackwashed core is seen at H.

The mould core is dried in the vertical position as made and thoroughly blackwashed, after which the internal core is located, again vertically. To locate the internal core, the tubes L are unscrewed and taken away until the core has been lowered into the mould core and pushed forward into the 4-in. core prints, until the shoulder N of the core H fits up to the cast-iron flanged ring E shown in Fig. 8. The vent tubes are next pushed through holes in the mould core, which correspond with the centre of the 4-in. core outlets, now screwed into the core again, secured by passing a rod through a hole provided in the vent tube and wedging on the outside of the core. Thus the core is held firmly and cannot fall or lift. No studs or chaplets are needed.

Assembly Details

An assembled section of the mould is shown at M, Fig. 9. A simple single vent is led off the mould section at Z from under the denseners at P. It will be remembered that the orthodox feeders are not employed in the process due to the effect of the mould material on liquid shrinkage. Relief riser gates R were located at approximately every 4 ft. along the length—one for each section of mould core. The riser gate connections S were 2 in. by 4 in., through which a ¼ section of aluminium was fixed; the

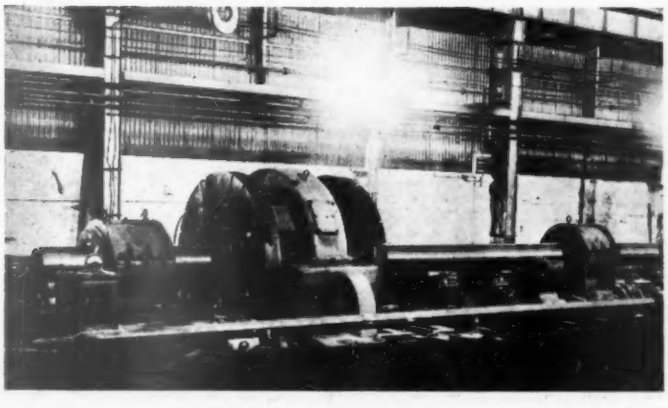

FIG. 14.—CORED BAR ARRANGED IN MACHINE WITHOUT THE WORK PIECE. COURTESY WM. BEARDMORE & COMPANY, LIMITED.

FIG. 15.—USE OF LARGE BORING BAR FOR CHAMBERING LARGE TUBES.

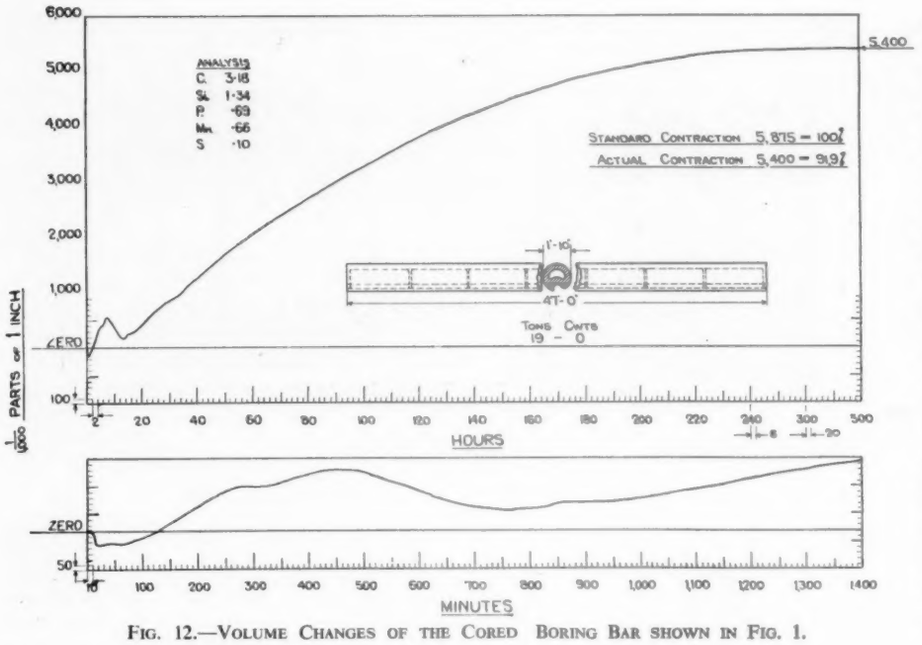

FIG. 12.—VOLUME CHANGES OF THE CORED BORING BAR SHOWN IN FIG. 1.

purpose of the aluminium was to hold up the metal denseners, which would fall out because of the ring or arch being broken, and also to create an exothermic reaction and ebullition immediately the molten metal appeared in the riser gate. This was done to aid in evacuation of gases and to pass off the dull metal from the upper face of the mould.

The assembly of the mould commences after having made a bed to receive the mould cores, with a downward camber in the centre of ¼ in. The assembled mould, in an advanced stage, is shown in Fig. 11. The open end of the mould is shown at U in the foreground. The other extreme end of the mould (47 ft. from U) is at the point X in the background of the picture. A high-pressure Craven-Longden drying unit is shown at I, which communicates by the pipe Q to the end of the mould. The pressure of hot gases delivered is sufficient to dry out the moisture which may have collected in the mould during the period of assembly, in one hour. The ends of the mould are closed in by flat slab cores carrying denseners through which ingates pass.

Pouring Arrangements

The mould is poured through two 1¼-in. dia. ingates located at each end of the mould, and eight fountain gates 1½ in. by 2 in., four being located on each side of the recess core Z, shown in Fig. 9, and spaced approximately at 4-ft. intervals from the centre of the mould. The connecting channels leading down to the fountain gates are shown partly exposed at A. These channels connect up to two 2½-in. dia. down gates leading to the pouring basin. When making the cores, silicon-carbide blocks are used about the ingate entrances where the metal may impinge; otherwise melting of the cast-iron blocks may occur.

After assembling the cores, and ramming around the sections and connecting up the runner gates and vents, covering boxes are located and rammed with sand, during which operation the riser gates are made. Three dried-loam pouring basins, one for each end and one for the centre, having been prepared, the riser-gate basins are next located and the job is weighted. Pouring is then carried out from three points from three ladles. The height of the pouring basins allows for a flow-off of metal from each riser gate.

The metal poured into the casting had the following composition:—Total carbon 3.18, silicon 1.34, manganese 0.66, sulphur 0.10, and phosphorus 0.69 per cent., and resulted in a perfectly sound casting.

The solid bar shown in Fig. 2 was poured under the same conditions and with similar metal, with equally successful results.

The cooling behaviour of the two bars dealt with is very interesting, and lends support to the points put forward, and Figs. 12 and 13 delineate their respective cooling curves.

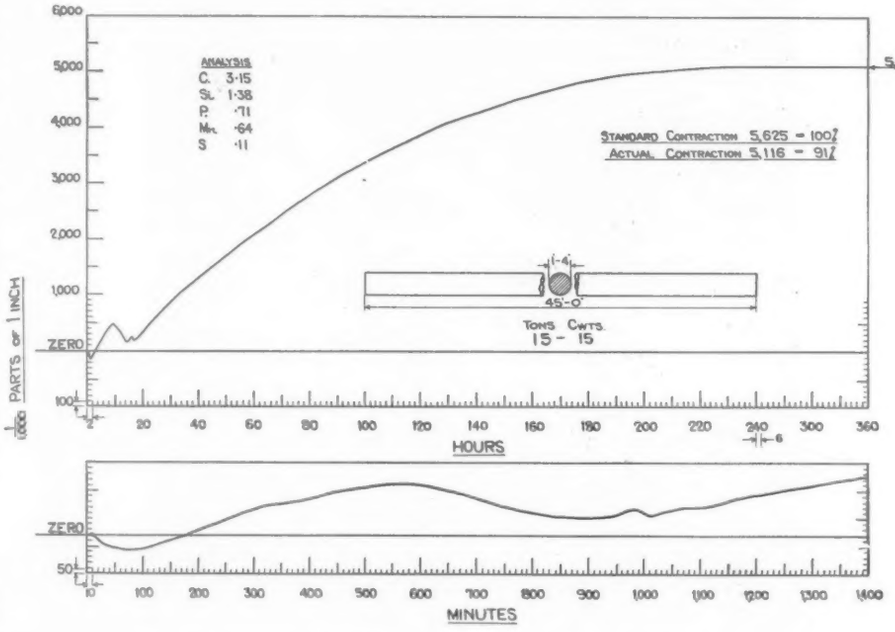

FIG. 13.—VOLUME CHANGES OF THE SOLID BORING BAR SHOWN IN FIG. 2.

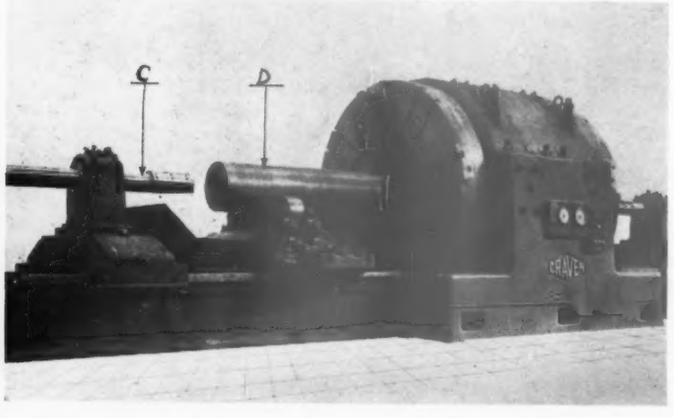

FIG. 16.—PRACTICAL APPLICATION OF BORING BAR.

Figs. 14, 15 and 16 illustrate the use of boring bars in large machine tools. In Fig. 14 the large cored bar is seen arranged in the machine without the work piece. One of the solid bars can be noted in the foreground of the photograph. Fig. 15 indicates the use of a large-diameter boring bar for chambering large tubes. The machine is shown as tested; the boring bar is indicated at A and the cast-iron test block at B. Fig. 16 shows the use of the smaller diameter bars, in which C indicates the boring bar and D the work piece.

In conclusion, the author's thanks are again tendered to Mr. J. R. Greenwood, chairman and managing director of Craven Bros., Limited, machine-tool engineers, for the facilities accorded for the conduct of the experimental work and for permission to present these data to the Institute.

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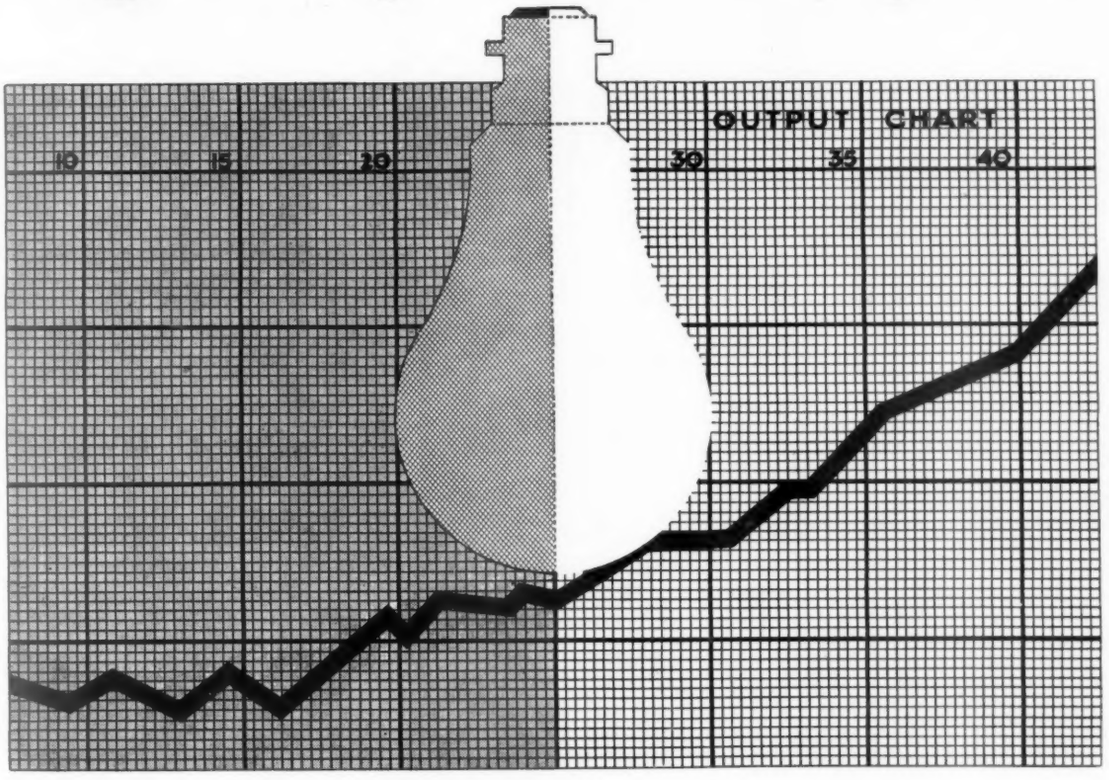

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Dendritic Structure

SHEFFIELD METALLURGICAL ASSOCIATION'S DISCUSSION

At a meeting of the Sheffield Metallurgical Association recently DR. C. H. DESCH gave an address on "Dendritic Structure," which was reviewed in our issues for November 28 and December 5. Appended are some extracts from the discussion.

DR. W. H. HATFIELD said that there were several outstanding facts which should be borne in mind when considering dendritic structures in steel. They were really typical of the higher range of lightly alloyed steel, nickel-chromium steel and steels of that character. But, when he heard Dr. Desch saying that the dendritic structures might, if very closely studied, provide some explanation of some of the difficulties that were experienced by some people in regard to steel, such as for instance the production occasionally of small cracks, he would really point out that the dendritic structure cancelled out.

Undestroyed Dendrites

The dendritic structure was common to large ranges of these steels, and was to be found in many of their most important products in an apparently undestroyed form. Since the steel had gone through quite a long range of time-temperature treatment from its initial cast condition and still the dendritic structure remained, he thought Dr. Desch would be the first to agree with him when he suggested pseudomorphism. Perhaps the correct analogy was that the apparently dendritic structure was not the cored structure of the original cast form, but responded to the etching medium probably for another reason, that reason being that the original dendritic structure was really marked out permanently, apart from composition, by the freezing of the non-metallic inclusions in the interstices of the dendrites. That, he thought, was a very important point, and it had this implication, that when they used their chemical methods of etching, as these inclusions were apt to prevent deposition in their vicinity, they might have in response to the etching a portion of a homogeneous metal brought out which resembled dendritic structure, when really the dendritic structure had long since passed and been replaced by the state of things that he had just described. That, he thought, was what really happened, and that was why he thought one was apt to confuse etching pictures and regard them as indicating the persistence of coring.

Continuing, the speaker said that did not alter the fact that Dr. Desch was undoubtedly right in insisting on some analogy between some of the other metallic solutions and the ferrous alloys, and that was why the Ingot Committee, and the Alloy Steel Committee, were hoping to be able to place at his disposal some of those huge crystals, of which Mr. Harry Dickinson had such a wonderful example, taken from the top of a large nickel-chromium ingot. But unfortunately, if they cast an ingot of 90, 120, or 200 tons, they could not, just for the sake of an experiment of this kind, cool that down in such a way as to give Dr. Desch the material in the condition in which he would really like it for examination. If in one of the big works in Sheffield it should happen some time that they had to preserve one of those large masses in the cast condition, he hoped that at the same time they would be fortunate enough to secure some of those big crystals and big dendritic structures and send them on to the lecturer.

Concluding, the speaker said he would like to emphasise that the dendritic structure, as disclosed in the finished product, could largely be taken to cancel out, and therefore, as such, should not be regarded necessarily as a cause of defects in the final product. Were it regarded so, many very important conditions of important steels would be eliminated from technology.

Coring and X-rays

DR. C. SYKES said his experience of coring had been chiefly gathered from attempts to produce specimens which would give quite good X-ray photographs. If one wanted to get an X-ray photograph which consisted of sharp lines, then it was necessary to remove all coring, and it was surprising how difficult this was. He remembered carrying out some experiments with a gold-copper alloy, which melted at about 975 deg. C., and he found that, in order to remove coring in that alloy, which was in the form of drawn wire, he had to anneal it for six hours at 950 deg. C. At first sight this result appeared very curious, because in the same alloy there was very definite evidence that the atoms could change places at temperatures as low as 80 deg. C. Coring extended over very long distances compared with the atomic spacing in alloys; consequently very long and thorough annealing was necessary to eliminate concentration gradients by normal diffusion processes.

DR. S. A. MAIN said he thought Dr. Hatfield was right in emphasising that apparent dendritic structures might not always represent as bad a state of affairs as they seemed to show; in other words, that they were, in many cases, only pseudomorphs or outlines of what was originally there, and so not very harmful—if dendritic structure could necessarily be regarded as harmful. He remembered being very much struck with a photomicrograph that his colleague Mr. Elliot once showed him, of a specimen of cast manganese steel. It had been reheated to about 1,100 deg. C. and water-quenched. There, of course, was the austenitic structure, but also, very distinctly, the ghost of the original dendritic structure, although complete recrystallisation had occurred in the quenching treatment. True, it was only a ghost, but it did suggest that the dendritic structure could be difficult to get rid of—or at any rate its outline—even when the original characteristics associated with that structure had been very greatly modified.

Chevenard's Method

With regard to the thermo-magnetic method, he thought that the most important use which Chevenard made of it was not so much in the nickel-chromium-tungsten steels referred to by Dr. Desch as in the high percentage nickel-chromium steels in which commercially there was some carbon. That carbon under certain conditions was deposited as particles of carbide, around each of which a halo was visible under the microscope. By the thermo-magnetic method, Chevenard was able to prove very clearly that in that halo the alloy was very much depleted of chromium, due to the formation of the chromium carbide. That fact was important in this way, namely, that if there was not sufficient nickel in the original alloy, then the material in the halo was rather low in both nickel and chromium contents, and therefore liable to chemical attack. If, on the other hand, there was sufficient nickel in the original alloy, then the fact that it was depleted of much of its chromium round these carbide particles did not matter so much; the alloy remained noble due to the high percentage of nickel, and as a whole, even although these carbides had been deposited, remained immune against chemical attack.

MR. D. A. OLIVER said he would like to ask if quantitative information was more likely to be found along the lines of the etching method, which he thought Dr. Desch put first in his list, and also whether he thought that the thermo-magnetic method was likely to be a close second. In connection with the thermo-magnetic method, his own view was that it was a delightfully simple method on paper, but extremely difficult to make quantitative. If one took the strongly ferro-magnetic elements, like iron, nickel and cobalt, nickel had very extraordinarily sluggish habits and very curious modes of behaviour. Even in pure iron-nickel alloys, he believed the subject was still very far from being solved, and consequently one was not in a position to go on to interpret the finer structure and the composition gradient. He should like to ask what pair of strongly ferro-magnetic metals Dr. Desch thought would be the best binary on which to attempt future work. He was sure they all welcomed an attempt, however difficult and protracted, to make something so fundamental as freezing a more quantitative science.

DR. A. H. JAY said that his experiences with ferrous alloys supported the statements of Dr. Sykes in his efforts to remove dendritic structure by heat-treatment. It was difficult to remove the final traces. The X-ray microscope of Hamos required a uniformly "bent" single crystal reflector. The speaker had not been able to obtain one. Dr. Desch had pointed out that the temperature interval between liquidus and solidus was a factor influencing the composition gradient in dendrites. It was equally important to consider the possible alloy range, especially when liquidus and solidus curves were almost parallel to the alloy axis, even when the temperature was only small. For obvious reasons he favoured the X-ray method for studying dendrites, (1) by transmission photographs, and (2) by the method of line broadening. The thickness of the cut slab would have to be judged according to the dimensions of the dendrites.

DR. D. W. DAVISON said that, as regards the transmission method for X-ray photography, he thought it was as well to emphasise the need for very thin sections. He knew that a large number of people nowadays recognised that X-ray penetration photography could be carried up to something like 4 in. of steel, and so one was apt to jump to the conclusion that a mass of steel that was 4 in. or less in thickness could be radiographed in order to bring out the dendritic structure. It had to be borne in mind, however, that the difficulty of obtaining high definition increased tremendously over one-eighth of an inch, and, while he thought certainly that good definition could be obtained with thin sheets, it was not possible, with present technique, to examine ingots before sectioning in order to see to what extent the dendritic structure had developed. Particularly he thought that, with fine-focus X-ray tubes, such as were particularly employed in magnesium alloys, it should be possible to do qualitative if not quantitative work on thin sections.

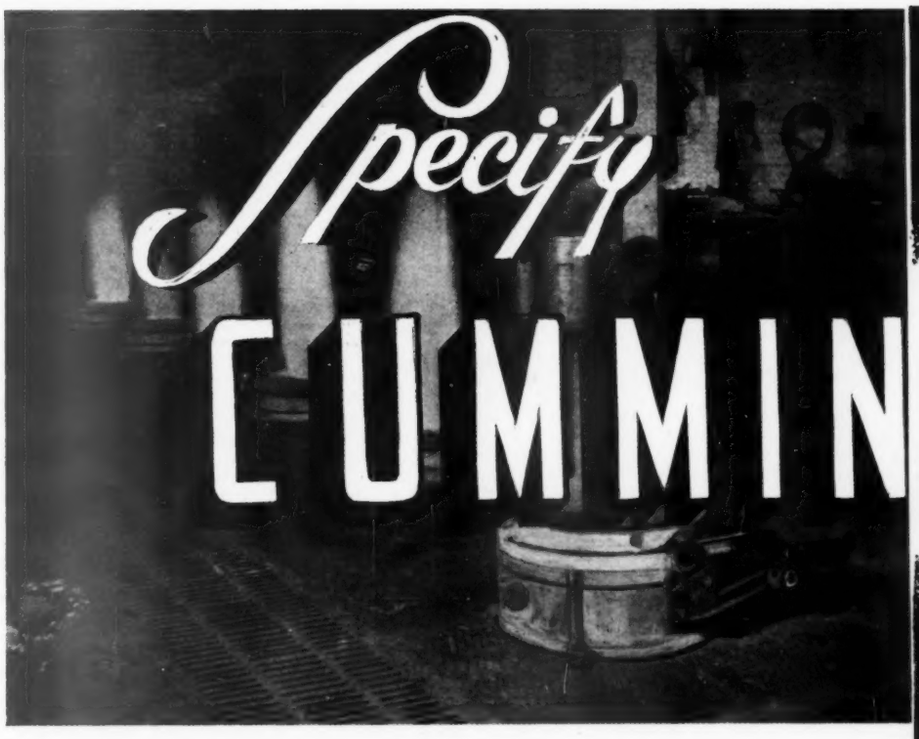
Author's Reply

DR. DESCH, in reply, said that Dr. Sykes had pointed out that diffusion, removal of coring, and so on, involved movement over long distances, and therefore was a much slower process than such rearrangement of atoms as he got in his gold-copper alloys, for example. He (the author) was glad Dr. Main did more justice to Chevenard than he had done. His method really was very valuable, but Chevenard pointed out himself that it naturally had only a limited applicability. It was only those alloys which happened to have Curie points which could be separated fairly well to which they could apply it, and, in fact, Chevenard had worked out some of his alloys quantitatively, showing the changes on annealing, and had then correlated those changes in magnetic properties with the changes in mechanical properties and in electrical resistance and so on—a very successful piece of work.

Dr. von Hamos came to see him, and he was very much impressed by the method. He had not seen the apparatus, but only the diagrams and the photographs published in the "Journal of Scientific Instruments," yet if it was a fact that they could not get these crystals, he was sorry, because the method seemed fairly good. He thought Dr. Jay would find people who could make those mirrors. The technique had been developed at Chicago. In reply to Mr. Oliver, as to which method he would put first, he thought the most promising was the chemical one for the present, and he thought a good deal of work might be done on that. In fact, in regard to the suggestions which were made about any experimental work to be done, he was afraid he was not in a position to carry them out, and he would have to hand them on to Dr. Sykes. In that gentleman's laboratory, Miss Hadfield particularly had been very much interested in this kind of study, and he hoped they would be able to pass some specimens to him.

Dr. Jay thought that the X-ray transmission method might be used on steels. The main difficulty, of course, was that the scale of the structure in a steel was usually rather small, and they would have to have their sections pretty thin, of the order of a tenth of a millimetre, and even then he was not sure how sharp the images would be. It was certainly quite worth tryng.

He was also pleased to hear Dr. Davison's remarks about transmission pictures. The work that was done in the French Air Ministry was only on light alloys, where there was a very considerable difference, of course, in absorptive power between the aluminium matrix and the crystals that were embedded in it, and in the ordinary steels there was not such a difference as that, but still he supposed that they could get even a fairly weak contrast and they could measure by doing measurements of density.



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The Week's News in Brief

Trade Talk

THE BLAW-KNOX COMPANY of Pittsburgh has received a substantial order for the supply of cast armour for tanks for the U.S. Government.

SIBOR HARD METALS, LIMITED, is being wound up voluntarily. Mr. E. F. Lermit, 26, Theobalds Road, Gray's Inn, London, W.C.1, is the liquidator.

BRITISH PIGIRONS, LIMITED, have left Abbey House, 2, Victoria Street, London, S.W.1, and have established a wartime emergency office at "Little Court," Pyrford Common, Woking, Surrey.

THE PARTNERSHIP between Messrs. Lewis James Kemp and Frederick Alan Wright, engineers and brassfounders, trading at 19A, Clinton Road, Forest Gate, as Kemp & Wright, has been dissolved by mutual consent. Debts will be received and paid by Mr. Frederick Alan Wright, who will continue the business under the style of F. A. Wright.

THE DIRECTORS of Leeds Piston Ring & Engineering Company, Limited, have received from Wellworthy Piston Rings, Limited, an offer to amalgamate the businesses by the purchase of the whole of the former's shares in consideration of preference and ordinary shares in the Wellworthy Company. The directors of the Leeds Piston Ring Company regard the offer as a favourable one for shareholders.

SIR PATRICK HANNON, M.P., was re-elected President of the National Union of Manufacturers at the annual meeting last week. In an address to the members, he said that nothing could be more stimulating in these days of peril than the harmony which prevailed throughout the vast field of industrial organisation. There was one aspect of recent public finance, of which manufacturers, however, had reason to complain. The fixing of E.P.T. at 100 per cent. by the Chancellor of the Exchequer would be a grievous blow to industrial reconstruction after the war. The business community had given the Chancellor whole-hearted support in his appeals, but he could not have given sufficient thought to the embarrassing position of the majority of manufacturers, and particularly of those who suffered in the lean years before 1937.

Personal

MR. P. L. JONES, technical manager at Swan, Hunter & Wigham Richardson, Limited, Neptune Engine Works, Walker-on-Tyne, has been nominated for the chairmanship of the Institution of Mechanical Engineers (North-Eastern branch) for a second term.

MR. PETER BENNETT, who will be the National Government candidate in the by-election in the Edgbaston Division caused by the death of Mr. Neville Chamberlain, is chairman and managing director of Joseph Lucas, Limited, and is a past-president of the Federation of British Industries. He is at present Director-General of Emergency Services in the Ministry of Aircraft Production.

SIR HAROLD E. YARROW, Bart., C.B.E., has been appointed a director of the Clyde Valley Electrical Power Company, Glasgow, and of its three subsidiaries, the Lanarkshire Hydro-Electric Power Company, the Strathclyde Electricity Supply Company, Limited, and the Clyde Valley Accessories, Limited. Sir Harold is chairman and managing director of Yarrow & Company, Limited, shipbuilders and engineers, Glasgow, and is a director of the Steel Company of Scotland, Limited.

Wills

DAVIS, A. G., of Bolton, iron and tool merchant	£5,077
KER, CHARLES, of Glasgow, vice-chairman of Bairds & Dalmellington, Limited	£92,204
PENNYMORE, LT.-COL. P. G., of Stourbridge, late of the Round Oak Steel Works, Limited	£848
EDDISON, H. T., of Leeds, a director of John Fowler & Company (Leeds), Limited, engineers and manufacturers of agricultural machinery	£26,954

Obituary

THE DEATH has occurred in a nursing home of Mr. John McCulloch, of A. & J. McCulloch, iron and steel merchants, West George Street, Glasgow.

MR. FREDERICK LEWIS TAYLOR, principal and one of the founders of Burford, Taylor & Company, Limited, engineers, Middlesbrough, has died at the age of 53.

MR. JOHN BARR died at his residence in Beckenham, Kent, last week, in his 82nd year. He had been a leading figure in the shipbuilding industry for upwards of half a century. Born near Barrow-in-Furness, he was associated with the late Sir James M'Kechnie in the development of what is now one of the greatest shipbuilding centres of the world—the Barrow works of Vickers-Armstrongs, Limited. At an early age Mr. Barr joined the staff of the Barrow Shipbuilding & Engineering Company, following on in the service of the Naval Construction & Armaments Company, the predecessors of Vickers at Barrow. In 1917 he became a director of Vickers, and remained with the firm until 1923. He was a past-president of the Shipbuilding Employers' Federation, and was until the time of his death a director of the Iron Trades Employers' Insurance Association.

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Uni-Gun Lubricating Equipment, Limited—Capital, £10,000. Subscriber: E. J. Crow, 24, Glenister Park Road, London, S.W.16.

P. & L. Miller, Limited, 19, Heneage Street, Spitalfields, London, E.1—Capital, £1,500. Electrical and mechanical engineers, founders, etc. Directors: P. and L. Miller.

Contracts Open

London, N., December 30—Castings and other ironwork, iron, steel, tools, etc., for the Islington Borough Council. Mr. W. Eric Adams, town clerk, Town Hall, Upper Street, London, N.1.

Lewes, December 30—Construction of approx. 920 yds. of 12-in. dia. cast-iron rising main, for the Borough Council. Mr. C. T. Butler, borough surveyor, Town Hall, Lewes, Sussex. (Fee £2 2s., returnable.)

Cupola Practice without Coke

The use of masout or natural gas in place of gas in the cupola is discussed by A. N. GOROSHANKIN and G. S. KATZOWSKI in "Liteinoje Djelo." Natural corundum can be used instead of a column of coke and the cupola tapped at a temperature of 1,380 to 1,400 deg. The cast iron obtained is stated to possess satisfactory properties, but improvements in the process can be made by slight changes in the design and operation of the furnace.

Giant Lifting Magnets

A coil-handling magnet, which on test has lifted a total load of 25 tons, has been been installed by the American Rolling Mill Company. The magnet was rated to lift about 18 tons, with a safety factor of 50 per cent. To meet the trend toward bigger and heavier coils of strip steel, the makers are now building five larger magnets of similar design, each with a rated capacity of nearly 75 tons, with a 50 per cent. safety factor.

New Russian Steelworks Planned

Separate commissions have been set up in the U.S.S.R. to select sites for new steelworks in Siberia and in the Southern Urals respectively. The Siberian plant scheduled for completion in 1944-45 is to be based on local ores and Kuznetsk coal, and the other, also based on local resources, is to be completed about the same time. The two works are intended to form the bases for the iron and steel industry in Siberia.

Reports and Dividends

Electric Furnace Company, Limited—Interim dividend of 3½ per cent.

Universal Grinding Wheel Company, Limited—Dividend of 10 per cent., tax free.

Aveling-Barford, Limited—Interim dividend on the ordinary shares of 5 per cent., free of tax.

Birmid Industries, Limited—Net profit, after tax, for the year to October 31 last, £133,884; brought in, £21,557; dividend of 10 per cent. and a bonus of 7½ per cent.; to reserve, £40,000; carried forward, £46,513.

Hepworth & Grandage, Limited—Profit, £61,840, after depreciation and E.P.T.; brought in, £23,984; income tax, £13,461; dividend of 12½ per cent.; to cash reserve, £20,000; special depreciation reserve, £3,000; carried forward, £22,182.

Wellworthy Piston Rings, Limited—Profit for the year ended July 31, after charging depreciation and taxation, £43,860; brought in, £6,696; dividend on the ordinary shares of 15 per cent.; to general reserve, £25,000; carried forward, after preference dividend, £10,330.

Shotts Iron Company, Limited—Profit for the year ended September 30, after providing for debenture interest and taxation, £70,511; brought in, £26,947; depreciation, £25,000; to reserve, £10,000; dividend on the ordinary shares of 5 per cent., £15,039; preference dividends, £3,912; carried forward, £43,507.

Atlas Steel Foundry & Engineering Company, Limited—Profit for the year ended September 30, £38,107; brought in, £8,847; depreciation, £5,000; general reserve, £10,000; investment reserve, £2,000; interim dividend of 15 per cent., £8,437; final dividend of 17½ per cent. and a bonus of 10 per cent., £15,469; carried forward, £6,048.

Broom & Wade, Limited—Full report for the year ended September 30 shows:—Trading profit, £99,944; depreciation, £12,130; income tax and E.P.T., £39,984; brought in, £26,705; dividends on the 6 per cent. cumulative preference shares, £6,900; interim dividend of 7½ per cent. on the ordinary shares, £11,250; final dividend of 15 per cent., £22,500; carried forward, £33,884.

Cargo Fleet Iron Company, Limited—Profit for the year ended September 30, £118,415; brought in, £96,744; interest on 4 per cent. debenture stock, £39,187; staff pensions and life assurance scheme, £6,090; sinking fund for 4 per cent. first mortgage debenture stock, £9,850; depreciation, £60,000; carried forward, £97,270. The directors state that the reduced profits are due to circumstances outside the control of the company, the undertaking being a controlled establishment.

Labour Recruitment and Good Housekeeping

(Continued from page 394.)

to hear that both the floor and the stockyard were kept clean by using a vacuum cleaner. It was no mean foundry either, as it was melting 80 tons per day. This foundry had not the glazed bricks the President referred to, but was nearly all glass.

In briefly seconding the resolution, which was carried with acclamation, MR. T. H. GAMESON reminded members that the President would need all the help members could give him in these difficult times. Given that assistance, he was sure he would handle the office satisfactorily, because in his personality he managed to express a certain efficiency which was bound to be useful to any organisation with which he was associated.

In introducing Mr. Francis, the BRANCH-PRESIDENT assured him that what the meeting lacked in numbers would be made up by the interest and enthusiasm of the members present that afternoon.

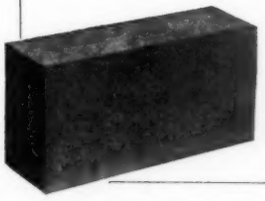
DR. W. H. HATFIELD, F.R.S., a director of Thos. Firth & John Brown, Limited, has been elected President of the Sheffield Society of Engineers and Metallurgists.

Delivery of firebricks from a local source

The manufacture and supply of firebricks which are consistently uniform in quality, according to grade, is the firm policy of "General Refractories." This policy is in operation in each of the many firebrick works under its control. These works are situated in various parts of the country and users are, therefore, able to select suitable firebricks from the "G.R." range and obtain delivery from the nearest sources of supply. This enables them to enjoy certain economies in delivery charges without sacrificing in any way the quality of their purchases. A brief list of "G.R." products is given alongside—for further details see catalogue. (A copy of the "G.R." Firebrick Catalogue will be sent on request).

"G.R." BRANDS OF FIREBRICKS

42/44% Al_2O_3
Glenboig Special
Glenboig Special Crown



36/38% Al_2O_3
Glenboig
Glenboig Crown
Hycone
Castlecary

34/35% Al_2O_3
Dykehead
Gem. Stour

24/32% Al_2O_3
Adamantine
Llangennech
White Carr

GENERAL REFRACTORIES LTD.

HEAD OFFICE: GENEFAX HOUSE, SHEFFIELD, 10. TELEPHONE 31113 (6 LINES)

BASIC BRICKS: *Spinella, Saxpyre, Supermag, Diazite, Dolomax.*
ACID-PROOF REFRACTORIES: *Obsidianite, Losol.*
INSULATION: *Amberlite* Bricks, Cement and Concrete.
SILICA BRICKS: *Lowood, Meltham, Allen, Quartex.*

CEMENTS: *Sintex, Durax, Pyrolite.* PLASTICS: *Durax, Rotaline, Plastic K-N., Glendol ine, Ground Ganister.*
SILLIMANITE: Tank Blocks, Bricks and Cements.
SANDS: Moulding, Brick Facing, Silica, Glass.

G.P.6

Raw Material Markets

While the position of the light-castings industry generally leaves much to be desired, there has been a welcome improvement during the past month or two, and many concerns are able to report better filled order-books. Government contracts have been more freely placed, while there has been an expansion of demand from the building trade, stocks in the latter having fallen to a low ebb. Heavy engineering concerns and speciality engineering establishments generally continue to be fully employed on work of national importance. Government departments' orders and other work of a high priority character account for the bulk of iron and steel output, but some ordinary domestic consumers are able to acquire reasonable tonnages if their requirements are for work of importance; while, considering the existing circumstances, the export trade has been kept up at a satisfactory level in recent months, although it cannot be expected that there will be any material expansion in this respect, as urgent home needs are tending to increase.

Pig-Iron

MIDDLESBROUGH—The manufacture of munitions and other projects involved in the war machine are absorbing the bulk of iron and steel supplies in this area. Ironmakers are mostly concerned with the production of iron for steelmaking and the output of ordinary foundry iron is very restricted: nor is any material expansion in the output likely to occur for some considerable time. Supplies of foundry iron are arriving here from the Midlands quite satisfactorily, however, although it is not generally possible to lay down reserve stocks on any large scale. The Northants and Derbyshire makers themselves have little in the way of stocks, but they appear to be meeting the substantial calls on their outputs with commendable promptitude. Transport irregularities are at times delaying deliveries, but, on the whole, users are being catered for quite satisfactorily. Foundrymen are now permitted to buy ahead of their requirements when this is possible, and it is hoped before long that useful stocks will be laid down.

Local output of hematite, coupled with increasing imports from abroad, is able to look after the urgent needs of consumers, but the tightness of the position has not been overcome and non-priority users have little opportunity to secure deliveries of any magnitude. Basic iron is in very heavy request for the steel furnaces, so that it is difficult to enlarge the production of hematite on the North-East Coast.

LANCASHIRE — Heavy electrical engineers, machine-tool manufacturers, and other speciality engineering concerns are well employed on contracts connected with the war effort and consumption of foundry iron in these sections is appreciable. The position of the jobbing foundries seems to have further deteriorated, while light-castings makers are also comparatively poorly situated, although certain of the latter are now better placed than they were a short time ago. Derbyshire and other Midland brands of foundry iron are arriving in large tonnages, and urgent needs are being met without delay. A moderate demand for forge iron is reported, while the call for hematite is maintained at a high level, though better deliveries would be welcomed.

MIDLANDS—Additional work is being placed by Government departments with makers of light castings, and many of them are able to operate their plant at a more satisfactory level than has been the case since the outbreak of the war, but a number of works are still in need of further business. This trade largely consumes high-phosphorus iron, which is available in adequate tonnages from Derbyshire and Northamptonshire furnaces. Builders continue to make heavier calls on the products of the light-castings foundries, and this factor is also playing a useful part in the better conditions now prevailing in this industry. Exports of light castings are still at a low ebb, and many works are handicapped by the quiet overseas demand. Heavy engineering works, of course, continue to be busy on Government contracts, and the demand for hematite and low-phosphorus iron is insistent, with quite a strong call for refined pig-iron. These descriptions are not freely available and strict control has to be exercised over allocations. On the whole, however, there is a good tonnage coming to hand to meet urgent demands.

SCOTLAND—While day-to-day requirements of pig-iron are being satisfied, there is little iron available for placing into stock, and at most consuming works reserves are non-existent. Local output is fully absorbed and recourse has to be made to the production of other districts. Reports from the Falkirk area indicate that the light-castings foundries could do with a greater volume of work, although some of them have been able to adapt their plants to deal with Government orders and have benefited accordingly. Very heavy tonnages of iron for the steelworks are being taken up.

Coke

Foundry coke consumers are able to purchase as much as they can take in. Where room for stocking still exists, most buyers are calling for deliveries to augment their reserves. Ovens generally have big stocks on hand, so that supplies are forthcoming promptly. All new business is conducted on the basis price f.o.t. works, which gives a delivered figure of 60s. 6d. per ton for Durham best coke, delivered to Birmingham and Black Country stations. This figure is subject to a rise-and-fall clause.

Steel

While the amount of steel for distribution in the United Kingdom is at record levels, non-priority users continue to be inconvenienced, owing to the vast tonnage required for Government contracts and the desirability of keeping imports down to the lowest possible level. Heavy joists, sections and angles are subject to slightly less delay than most other products in some districts, but the pressure on the steel industry remains insistent. The Government munitions programme has got well into its stride, and the tendency will be for still larger tonnages of steel to be requisitioned by the various Service departments. Shipyards, being very active, are taking up substantial deliveries of suitable steel.

Scrap

The introduction of higher selling prices for iron and steel scrap, announced in these columns last week, was favourably received by the merchanting trade. The increase includes an allowance for increased railway rates and also a contribution to merchants' higher working costs. Nearly all descriptions of scrap are in abundant supply and users' needs are being met without delay. Steelworks, foundries and engineering shops are consuming big tonnages and no relaxation is permitted in the collection of additional supplies. Business has fallen away to some extent of late, as many buyers have large stocks on hand.

Metals

Supplies of copper appear to be quite sufficient to satisfy the heavy needs of war contracts and imports, it would seem, are arriving at ports in the United Kingdom on a good scale. While the requirements of priority users are being well met, there is little metal to spare for non-essential purposes, nor is there likely to be a great deal in the near future. Consumption of copper in the United States is forging ahead, and the defence programme of the Government will certainly account for substantial tonnages as additional contracts are placed.

The American Copper Institute has announced the following statistics:—Production of crude for November, 84,507 tons, against 86,911 for October; production of refined, 96,283, against 83,076; deliveries to domestic consumers, 102,483, against 103,771; export shipments, nil, against nil; refined stocks at end of month, 158,418, against 164,618.

Little change has taken place in the London tin market, conditions remaining on the quiet side, with prices steady. Business in America, too, is rather dull, especially among general consumers, but buying on Government account is proceeding steadily.

Mr. A. Burt, chairman of United Tin Areas of Nigeria, Limited, is yet another representative of the tin-mining industry to ventilate opinions on the inequity of the Excess Profits Tax as it affects tin producers. Speaking at the annual meeting of the company, last week, Mr. Burt said that the so-called Excess Profits Tax was, in effect, to a considerable extent a confiscation of capital in cases like theirs. They certainly thought this industry was entitled to further consideration of its special circumstances by the Chancellor.

The total visible supply of tin on November 30 was 33,127 tons, against 34,311 tons on October 31, according to figures compiled by Mr. W. H. Gartsen (Henry Rogers, Sons & Company). The carry-over in the Straits Settlements was 3,811 (3,815) tons, while the carry-over at principal European smelters was 3,073 (2,580) tons.

London Metal Exchange tin prices this week have been as follow:—

Cash—Thursday, £257 to £257 5s.; Friday, £257 to £257 5s.; Monday, £257 to £257 5s.; Tuesday, £257 5s. to £257 10s.

Three Months—Thursday, £259 15s. to £260; Friday, £260 to £260 5s.; Monday, £259 15s. to £260; Tuesday, £260 to £260 5s.

Considerable discretion is being exercised in the distribution of spelter, not because there is any shortage, but in order to safeguard the future. Priority users, of course, are receiving their full requirements, and it is only unessential consumers who are experiencing difficulty. In direct contrast to the situation prevailing in Germany, lead supplies here are more than sufficient to meet all needs.

Buyers of non-ferrous scrap seem to be eager to reduce their stocks before the end of the year, and business has fallen away to some extent. Most descriptions of scrap are freely available, and some sorts are, in fact, proving difficult to move from holders' yards.

Titanium in Foundry Practice

The use of about 5 lbs. of high-carbon ferro-titanium per ton is stated to be fairly general practice amongst American manufacturers of steel castings, when making the intermediate grade of manganese steel. This treatment, according to GEORGE F. COMSTOCK, writing in "Metal Progress," is stated to result in a better combination of strength, ductility and impact values than would be given by either stronger or weaker deoxidation in that grade of steel. He also reports on Jominy's new development in the use of titanium in cast iron. This element is used in somewhat more than the usual percentages for improving the wear-resistance of cylinder liners in internal-combustion engines. This has been the subject of two recent Patents. The chief commercial use of titanium in cast iron continues at present, however, to be for deoxidation, grain-refinement and graphitising, the high-carbon ferro-titanium being most used in electrically-melted cast iron, and a low-carbon ferro-silicon-titanium for iron melted in the cupola.

Improved Foundry Practice

MR. H. H. HARRIS, in "Metal Progress," credits researches of the Alloy Casting Research Institute at Battelle Memorial Institute and of the Chemical Foundation at Massachusetts Institute of Technology as being fruitful, but they have, he says, as yet had little influence on the industry. The principal progress in heat- and corrosion-resisting castings has come from improved methods of heat-treatment, inspection and finishing and better foundry practice:—(1) Control over the gas content of the melt; (2) control of grain size in the casting by controlling its pouring temperature and cooling rate, the latter by varying the capacity for heat absorption by appropriate portions of the mould; (3) control of shrinkage and strain by various expedients—(*a*) "yielding" and "non-yielding" sections in the same mould, (*b*) pouring from two or more ladles of planned differences in temperature, (*c*) innovations in gating procedure; (4) improved varieties of synthetic sands; (5) use of semi-permanent moulds; and (6) pressure-casting to secure more uniform density than is possible with conventional sand-casting or centrifugal-casting practice.

ALUMINIUM ALLOYS

for your most intricate casting

The increasingly exacting demands made by the swift march of engineering progress finds the development in the Aluminium Alloys produced by this organization, steadily keeping pace.

Designers, foundrymen and engineers know that whenever an Aluminium Alloy to a new specification is required, International Alloys Limited can be relied upon as the best source of supply.

INTERNATIONAL ALLOYS LTD
SLOUGH BUCKS

TELEGRAMS INTALLOYD SLOUGH ★ TELEPHONE SLOUGH 23212

RAW MATERIALS—PRICE LIST

Wednesday, December 18, 1940

COPPER*

	£	s.	d.
Electrolytic	62	0	0
High-grade fire-refined ..	61	10	0
Fire-refined of not less than 99.7 per cent.	61	0	0
Do., do., 99.2 per cent. ..	60	10	0
Black hot-rolled wire rods..	65	10	0

TIN

(Closing prices December 17)

Standard cash	257	5	0
Three months	260	0	0
Settlement..	257	5	0
Official average Cash, Nov.	258	7	6
Do. Three Months, Nov.	260	5	1⅜
Do. Settlement, Nov. ..	258	6	5½

SPELTER*

G.O.B. (foreign) (duty paid)	25	15	0
Do. (domestic).. ..	26	10	0
"Prime Western" ..	26	10	0
Refined and electrolytic ..	27	5	0
Not less than 99.99 per cent.	28	15	0

LEAD*

Good soft pig lead (foreign) (duty paid)	25	0	0
Do., do., (Empire and domestic)	25	0	0
English	26	10	0
Sheets, home	34	10	0
Do. export, f.o.b. ..	30	0	0
Pipes, home	34	0	0
Do. export, f.o.b. ..	30	10	0
Tea lead (nom.)		—	

ALUMINIUM

Ingots	£110
Wire, 10g.	nom.
Sheets	nom.
Circles, 20/24g.	nom.

ZINC SHEETS, etc.

	£	s.	d.
Sheets, 10g. and thicker, ex works..	39	2	6
Rolled zinc (boiler plates), ex works..	37	2	6
Zinc oxide (Red Seal), d/d buyers' premises ..	28	7	6

ANTIMONY

English, 99%, delivered ..	85	0	0
Foreign Regulus, duty paid .. 88 0 0 to	91	0	0
Chinese, prompt shipment, c.i.f. .. 76 0 0 to	80	0	0

QUICKSILVER

Quicksilver, ex-w'hse London 48 0 0 to 50 0 0

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten 3s. 0d.
Finished bars, 18% tungsten 3s. 10d.
Finished bars, 22% tungsten 4s. 4d.
Per lb. d/d buyers' works.

NICKEL SILVER, etc.

	Per lb.
Ingots for re-rising ..	9d. to 1/3
Rolled—	
To 9 in. wide ..	1/3 to 1/9
To 12 in. wide ..	1/3½ to 1/9½
To 15 in. wide ..	1/3½ to 1/9½
To 18 in. wide ..	1/4 to 1/10
To 21 in. wide ..	1/4½ to 1/10½
To 25 in. wide ..	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/– to 1/8½
Wire round—	
to 10g.	1/6½ to 2/1½

with extras according to gauge.

Special 5ths quality turning rods in straight lengths, 1/5½ upwards.

* Maximum prices per long ton delivered to buyers' premises.

FERRO-ALLOYS AND STEEL-MAKING METALS

(all prices nominal.)

Ferro-silicon (5-ton lots)—	£ s. d.
25%	18 10 0
45%	23 10 0
75%	36 10 0
Ferro-vanadium—	
35/50%	15/6 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free ..	6/– lb. Mo.
Ferro-titanium—	
20/25% carbon-free ..	1/9 lb.
Ferro-tungsten—	
80/85%	5/1 lb.
Tungsten metal powder—	
98/99%	5/2½ lb.
Ferro-chrome—	
2/4% car.	—
4/6% car.	47 0 0
6/8% car.	47 0 0
8/10% car.	—
Ferro-chrome—	
Max. 2% car.	—
Max. 1% car.	—
Max. 0.5% car... ..	—
70% carbon-free	—
Nickel—99.5/100%	£190 to £195
"F" nickel shot ..	175 0 0
Ferro-cobalt, 98/99% ..	8/9 lb.
Metallic chromium—	
96/98%	3/9 lb.
Ferro-manganese—	
76/80% loose	18 10 0
76/80% packed	20 0 0
Metallic manganese—	
94/96% carbon-free ..	1/9 lb.

Per ton unless otherwise stated, basis 2-ton lots, d/d Sheffield works.

SCRAP*

	£ s. d.	£ s. d.
SOUTH WALES—		
Short heavy steel, not ex. 24-in. lengths ..	4 2 0	to 4 4 6
Heavy machinery cast iron		4 7 0
Ordinary heavy cast iron		4 2 0
Cast-iron railway chairs		4 7 0
Medium cast iron ..		3 18 3
Light cast iron		3 13 6
MIDDLESBROUGH—		
Short heavy steel	3 19 9	to 4 2 3
Heavy machinery cast iron		4 11 9
Ordinary heavy cast iron		4 9 3
Cast-iron railway chairs		4 9 3
Medium cast iron ..		3 19 6
Light cast iron		3 14 6
BIRMINGHAM DISTRICT—		
Short heavy steel	3 14 9	to 3 17 3
Heavy machinery cast iron		4 12 3
Ordinary heavy cast iron		4 7 6
Cast-iron railway chairs		4 7 6
Medium cast iron ..		4 0 3
Light cast iron		3 15 3
SCOTLAND—		
Short heavy steel	3 19 6	to 4 2 0
Heavy machinery cast iron		4 14 3
Ordinary heavy cast iron		4 9 3
Cast-iron railway chairs		4 14 3
Medium cast iron ..		3 17 3
Light cast iron		3 12 3

* Delivered free to consumers' works in England and Wales. For deliveries of cast-iron scrap free to consumers' works in Scotland, the above prices less 3s. per ton, but plus actual cost of transport or 6s. per ton, whichever is the less. All prices: Plus 3½ per cent. dealers' remuneration: 50 tons and upwards over three months 2s. 6d. extra.

PIG-IRON*

N.E. COAST (d/d Tees-side area)—	
Foundry No. 1	131/–
„ No. 3	128/–
„ No. 4	127/–
Forge No. 4	127/–
Hematite No. 1	138/6
Hematite M/Nos.	138/–
N.W. COAST—	
Hem. M/Nos. d/d Glasgow	138/6
„ d/d Birmingham ..	150/–
MIDLANDS (d/d Birmingham dist.)—	
Staffs No. 4 forge	129/–
„ No. 3 fdry.	130/–
Northants forge	126/6
„ fdry. No. 3 ..	127/6
„ fdry. No. 1 ..	130/6
Derbyshire forge	129/–
„ fdry. No. 3 ..	130/–
„ fdry. No. 1 ..	133/–
Phosphorus 0.5% to 0.75%	137/6
Phosphorus 0.1% to 0.5%	140/6
SCOTLAND—	
Foundry No. 1, Grangemouth	127/3
„ No. 3, Grangemouth	124/9
Cleveland No. 3, Glasgow	131/–
„ „ Falkirk ..	128/–
Scottish hem. M/Nos. d/d..	138/6
SHEFFIELD (d/d district)—	
Derby forge	126/6
„ fdry. No. 3 ..	127/6
Lincs forge	126/6
„ fdry. No. 3 ..	127/6
W.C. hematite	144/–
LANCASHIRE (d/d eq. Man.)—	
Derby fdry. No. 3 ..	133/–
Staffs fdry. No. 3	133/–
Northants fdry. No. 3 ..	131/6
Cleveland fdry. No. 3 ..	133/–
Cylinder and Refined Irons	
North Zone..	174/–
South Zone..	176/6
Refined Malleable	
Birmingham and S. Staffs	171/6
Cold Blast	
South Staffs	220/6

* Prices of hematite and basic pig-iron, and of foundry and forge iron with a phosphoric content of not less than 0.75 per cent., are subject to a rebate of 5s. per ton under certain conditions.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms and Slabs.

	£ s. d.
BASIC:	
Soft, u.t., 100-ton lots ..	12 5 0
Tested, up to 0.25% C. ..	12 10 0
Tested, 0.25 to 0.33% C.	12 12 6
Tested, 0.33 to 0.41% C...	12 15 0
Hard (0.42 to 0.60% C.)..	13 17 6
„ (0.61 to 0.85% C.)..	14 7 6
„ (0.86 to 0.99% C.)..	14 17 6
„ (1% C. and up) ..	15 7 6
Silico-manganese	16 5 0
Free-cutting	14 10 0
SIEMENS MARTIN ACID	
Up to 0.25% C.	15 15 0
Case-hardening	16 12 6
Silico-manganese	16 5 0

Billets, Blooms and Slabs for Forging and Stamping.

Basic soft, up to 0.25% C. ..	13 17 6
Basic hard, 0.41 to 0.60% C.	14 10 0
Acid, up to 0.25% C. ..	16 5 0

Other Semi-products, etc.

Tin bars	12 2 6
Sheet bars	12 2 6
*Wire rods, soft basic ..	17 7 6
„ hard basic ..	21 2 6
„ free-cutting ..	20 2 6
„ acid	24 13

* Subject to rebate

FINISHED STEEL

Usual district deliveries.

[A rebate of 15/- per ton for steel bars, sections, plates, joists and hoops is obtainable in the home trade under certain conditions.]

	£	s.	d.
Plates, ship (N.E. Coast) ..	16	3	0
Boiler plts. (N.E. Coast) ..	17	0	6
Chequer plts. (N.E. Coast)	17	13	0
Angles, over 4 un. ins. ..	15	8	0
Tees, over 4 un. ins. ..	16	8	0
Joists, 3 in. × 3 in. and up	15	8	0
Rounds and squares, 3 in. to 5½ in.	16	8	0
Rounds under 3 in. to ⅜ in. (untested)	17	12	0
Flats—over 5 in. wide ..	15	13	0
„ 5 in. wide and under ..	17	12	0
Rails, heavy, f.o.t. ..	14	10	6
Hoops	18	7	0
Black sheets, 24 g. (4 t. lots)	22	15	0
Galv. cor. shts. („)	26	2	6
Galv. flat shts. („)	26	12	6
Galv. fencing wire, 8g. plain	26	17	6

FINISHED IRON

	£	s.	d.
CROWN IRON:			
England and Wales ..	15	12	6
Scotland	15	12	6
Ireland, f.o.q.	16	5	0
No. 3 BARS:			
England and Wales ..	12	10	0
Scotland	13	12	6
Ireland, f.o.q.	13	2	6
No. 4 BARS:			
England and Wales ..	13	0	0
Scotland	13	17	6
Ireland, f.o.q.	13	12	6
STRIP:			
England and Wales ..	17	0	0
STAFFS MARKED BARS, f.o.t...		—	

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated, November 14, 1940.

	Dols.
No. 2 foundry, Phila.	24.84
No. 2 foundry, Valley	23.00
No. 2 foundry, Birm.	19.38
Basic, Valley	22.50
Malleable, Valley..	23.00
Grey forge, Valley	22.50
Ferro-mang., seaboard	120.00
O.-h. rails, h'y, at mill	40.00
Billets	34.00
Sheet bars	34.00
	Cents
Iron bars, Chicago	2.25
Steel bars	2.15
Tank plates	2.10
Beams, etc.	2.10
Wire rods	2.00
Skelp, grooved steel	1.90
Steel strip	2.10
Steel sheets	2.10
Sheets, galv., 24 g.	3.50
Wire nails	2.55
Plain wire	2.60
Tinplates, 100-lb. box	$5.00

COKE (at ovens)

(nominal)

Welsh foundry	46/6 to 48/–
„ furnace	35/6 to 37/–
Durham foundry	42/–
„ furnace	35/6
Scottish foundry	45/– to 50/–
„ furnace	35/6

TINPLATES

(f.o.b Bristol Channel ports)

I.C. cokes	20 × 14 per box	30/9 to 32/–
„	28 × 20 „	61/6 to 64/–
„	20 × 10 „	44/3 to 44/9
„	18¾ × 14 „	32/– to 32/6
C.W.	20 × 14 „	27/9 to 28/9
„	28 × 20 „	55/6 to 57/6
„	20 × 10 „	42/3 to 42/9
„	18¾ × 14 „	30/– to 30/6

NON-FERROUS SCRAP
(Official Maximum Prices, per ton ex Works.)

	£ s. d.
Bright untinned copper wire, in crucible form or in hanks	57 10 0
No. 1 copper wire	57 0 0
No. 2 copper wire	55 10 0
Copper firebox plates, cut up	57 10 0
Clear untinned copper, cut up	56 10 0
Brazier copper	53 10 0
Q.F. process and shell-case brass, 70/30 quality, free from primers	49 0 0
Clean fired 303 S.A. cartridge cases	47 0 0
70/30 turnings, clean and baled	43 0 0
Brass swarf, clean, free from iron and commercially dry	34 10 0
New brass rod ends, 60/40 quality	38 10 0
Hot stampings and fuse metal, 60/40 quality	38 10 0
Admiralty gunmetal, 88-10-2, containing not more than ¼ per cent. lead or 3 per cent. zinc, or less than 9½ per cent. tin	72 0 0

NEW BRASS TUBES, etc.

	Per lb.
Solid drawn tubes	13½d.
Brazed tubes	15½d.
Rods, drawn	11½d.
Rods, extd. or rlld.	8½d.
Sheets to 10 w.g.	10½d.
Wire	10½d.
Rolled metal	9½d.
Yellow metal rods	8½d.

COPPER TUBES, etc.

Solid drawn tubes	14½d.
Brazed tubes	14½d.
Wire	9½d.

PHOSPHOR BRONZE

	Per lb. basis
Strip	13½d.
Sheet to 10 w.g.	13½d.
Wire	15½d.
Rods	15½d.
Tubes	20½d.
Castings	17d.

Delivery 3 cwt. free.
10% phos. cop. £35 above B.S.
15% phos. cop. £40 above B.S.
Phosphor tin (5%) £40 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

AVERAGE MONTHLY PRICES OF DERBYSHIRE NO. 3 FOUNDRY AT MANCHESTER.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1934	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6
1935	2 13 0	2 13 0	2 11 6	2 12 6	2 12 0	2 12 0	2 12 3	2 14 0	2 16 6	3 0 0	3 0 6	2 14 1	
1936	3 2 0	3 5 0	3 3 0	3 0 6	2 17 0	2 18 6	2 18 0	2 16 6	2 19 0	3 0 6	3 1 6	3 7 0	0 8½
1937	3 7 0	3 7 0	3 5 0	3 2 0	3 4 0	3 8 0	3 6 0	3 5 0	3 4 0	3 2 6	3 1 0	2 18 6	3 4 2½
1938	2 15 0	2 14 6	2 14 6	2 15 6	2 14 0	2 13 0	2 13 0	2 11 6	2 12 6	2 13 9	2 12	2 12 6	2 13 8½
1939	2 13 0	2 12 6	2 11 6	2 12 0	2 12 6	2 12 6	2 12 0	2 12 6	2 14 6	2 15 0	2 14 6	2 14 0	2 13 0½
1940	2 13 9	2 14 0	2 14 0	2 14 4	2 15 0	2 15 0	2 14 9	2 15 0	2 15 0	2 15 0	2 15 0	2 15 0	2 14 7½
1941	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 14 6	2 15 0	2 15 0	2 15 8
1942	2 17 4½	2 17 6	2 17 6	3 1 1½	3 2 6	3 3 9	3 6 3	3 7 6	3 10 10½	3 12 6	3 13 3½	3 14 6	3 5 4
1943	3 15 7	3 15 0	3 11 10½	3 11 4½	3 10 2½	3 6 10½	3 4 2½	3 2 9	3 1 9	3 1 0	2 19 3	2 17 2½	3 6 5
1944	2 17 2½	2 18 0	2 18 0	2 17 0	2 17 0	2 16 7½	2 16 0	3 2 10	3 1 0	2 19 9½	2 16 11½	2 18 1½	2 18 2½
1945	3 1 2	3 3 11	3 5 9	3 18 8½	3 13 7	3 14 1	3 15 0	3 13 3	3 12 0½	3 11 1	3 14 0	4 3 3	3 12 2½
1946	4 4 6½	4 11 6	4 11 6½	4 7 6	4 7 6	4 7 6	4 10 0	4 12 10	4 12 6	4 12 6	4 12 6	4 12 6	4 8 6
1947	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6
1948	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6
1949	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6
1950	9 13 9	10 0 0	10 5 3	10 15 3	11 10 0	12 2 6	12 5 0	13 1 3	14 7 6	14 5 0	14 5 0	14 5 0	12 12 1
1951	12 11 8	10 8 9	9 2 6	8 2 0	8 0 0	8 0 0	8 0 0	8 1 8	7 4 0	6 7 6	5 7 6	4 16 10	8 0 2½
1952	5 5 0	4 17 6	4 15 0	4 15 0	4 12 6	4 12 6	4 12 6	4 12 6	4 11 3	4 10 0	4 10 0	4 10 0	4 13 7½
1953	4 12 8½	5 0 2	6 2 6	6 6 7½	6 2 5	5 11 9	5 9 1½	5 4 0	5 0 0	5 0 9	5 0 7	5 2 9	5 7 11½
1954	5 3 0	5 3 0	5 3 0	5 3 0	5 3 0	5 2 10	5 1 3	4 17 11	4 15 6	4 13 6	4 10 1½	4 10 0	4 10 3	4 17 9
1955	4 10 0	4 9 0	4 6 9	4 5 2½	4 3 0	4 0 1½	4 17 1½	3 15 7½	3 14 3½	3 13 4½	3 13 4½	3 13 2½	4 1 9
1956	2 14 9	3 15 3	3 15 6	3 15 3½	3 17 6	4 5 9	4 16 9	*	*	*	*	4 12 6	4 0 1½
1957	4 13 9½	4 13 3	4 11 1½	4 9 4½	4 6 1½	3 19 1½	3 16 1½	3 15 6	3 13 4½	3 13 4½	3 14 0	3 13 0½	4 1 0½
1958	3 12 2½	3 12 3	3 12 3	3 11 8	3 10 0	3 8 3	3 7 8½	3 7 6	3 7 9½	3 8 3	3 8 3	3 7 6	3 9 10½
1959	3 8 3½	3 10 4½	3 10 10½	3 11 0	3 11 2½	3 12 0	3 12 4½	3 14 6	3 15 1½	3 17 0	3 17 0	3 17 0	3 13 1½
1960	3 17 0	3 17 0	3 17 0	3 17 0	3 17 0	3 17 0	3 15 0	3 12 0	3 12 0	3 12 0	3 10 1½	3 9 6	3 14 4½
1961	3 9 6	3 9 6	3 9 6	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 10
1962	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0
1963	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0
1964	3 7 0	3 9 6	3 13 2½	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 13 11½
1965	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0
1966	3 18 0	3 18 0	3 18 0	3 18 0	3 18 0	3 18 0	3 18 0	3 14 0	3 14 0	3 14 0	3 18 0	3 18 0	3 14 8
1967	4 9 0	4 9 0	4 9 0	4 9 0	4 9 0	4 9 0	4 9 0	4 3 0	4 3 0	4 3 0	4 3 0	4 9 0	4 1 0
1968	5 14 0	5 14 0	5 14 0	5 14 0	5 14 0	5 14 0	5 14 0	5 9 0	5 9 0	5 9 0	5 9 0	5 14 0	4 19 10
1939	5 4 0	5 4 0	5 4 0	5 4 0	5 4 0	5 4 0	5 14 0	5 14 0	5 14 0	5 14 0	5 14 0	5 14 0	514 0
1940	5 13 0	5 16 0	5 16 0	5 16 0	5 16 0	5 16 0	6 5 0	6 5 0	6 5 0	6 5 0	6 13 0	—	—

NOTE: Prices have been subject to a rebate of 5/- per ton since November 1, 1937. * No prices available during strike period.

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All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

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(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

TO ENGINEERS AND IRONFOUNDERS.—Expert advice given to ironfounders who are in difficulties owing to shortage of low-phosphorus pig-irons. 30 years' experience in the mixing of irons. Analyses and mechanical tests accurately undertaken.—Apply to A. R. SCOTT, Metallurgist, New Whittington, Chesterfield.

WANTED by large Grey Iron Foundry in Midlands, Chemist, with experience in control of Moulding Sand and Core Sand Mixtures. Splendid opportunity for the right man.—BOX 578, Offices of THE FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

SUPERINTENDENT of Employment for large Engineering Works in Hertfordshire. Duties would include supervision of labour engagement; also training schemes for apprentices and trainees.—State age, experience and salary required to Box 588, Offices of THE FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

EMPLOYMENT REGISTER.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

ASSISTANT FOREMAN with sound and varied experience on light castings, machine tools, etc., desires position as foreman. Exceptionally good technical training, successful engineering student. Experienced in repetition light castings. Highest recommendations. (392)

MACHINERY

FOR SALE.—One Junior Motive Type Sandslinger, built by the Foundry Plant & Machinery, Ltd., and only recently put into work. Travelling type with 7-tons sand bin with 12-ft. radius arm. The machine is complete and in first-class condition. Can be seen by appointment.—SIR JAMES FARMER NORTON & CO., LTD., Adelphi Iron Works, Salford 3, Manchester.

PNEUMATIC MOULDING MACHINES

Macdonald Jolter, table 72 in. by 54 in.

Tabor ditto, table 27 in. by 20 in.

Tabor 21 in. by 16 in. squeeze.

Zimmerman Type R.P.W. 2 Jolt Squeeze turnover, table 36 in. by 20 in.

Mumford Type (Jackman) Swing Headpress, 13 in. by 15 in. and 14 in. by 16 in.

Mumford Pneumatic Core Jolters having 15-in. by 20-in. and 12-in. by 12-in. tables.

Britannia No. 1 "Coventry" Pneumatic Turnover Jarr Ram, table 30 in. by 28 in.

50 Air Compressors; 500 Electric Motors, Dynamos, etc.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.
CROSSWELLS ROAD, LANGLEY,
Nr. Birmingham.
'Phone: Broadwell 1359.

MACHINERY—*Continued*

NEW Dwarf Cupola, to melt 10 to 15 cwts. per hour; New Worm-geared Ladles, 4-tons, 2-tons, 30-cwts., 20-cwts., 15-cwts. and 10-cwts. capacity; also Osborn Cupola Spark Arresters.—T. DAVIES & SON, West Gorton, Manchester, 12.

SAND MIXERS AND AERATORS.—The "Breakir" Centrifugal Machine is *THE* machine. Outputs 10 cwts. to 8 tons per hr.—W. BREALEY & CO. LTD., Station Works, Ecclesfield, Sheffield.

THOS. W. WARD, LTD.

No. 16 "Brown & Sharpe" PLAIN GRINDING MACHINE, 12-in. by 72-in. capacity; 2 wheel speeds; 12 table speeds; 8 work speeds; 18-in. dia. wheel.

"Modern" PLAIN GRINDING MACHINE, 8-in. by 30-in. capacity; maximum swing, 9 in.; admit 14-in. by 2-in. face wheel; self-contained countershaft drive; 10 h.p. required to operate.

Write for "Albion" Catalogue.

ALBION WORKS, SHEFFIELD
'Grams: "Forward." 'Phone: 26311 (15 lines).

MISCELLANEOUS

WANTED FOR OUR OWN WORKS.

ZINC ALLOY, ZINC DIE-CAST
Scrap, Dross and Turnings.
PURE CADMIUM, CADMIUM ALLOY
Scrap Dross and Turnings.
LEAD BRONZE
Scrap Dross and Turnings.
ALUMINIUM AND ALLOYS
Dross, Filings and Sawings.

Offers with samples to OAKLAND METAL COMPANY, LIMITED, Oakland Works, Oaklands Road, London, N.W.2.

"A STUDY IN ECONOMY"
ACTUAL MANUFACTURES
BY USING OUR

Foundry Blackings, Facings, Parting Powder, Core Gum, Terra Flake, Talc Coal Dusts Ganister, Ceylon Plumbago (Imports direct) We definitely help to produce perfect Castings Only the best minerals used in the making A trial order will convince users of their economic value.

JOHN & C. DURRANS,
PENNINE WORKS, HALLEHEAD,
NEAR SHEFFIELD.

Telephone: 128 Penistone. Telegrams: Facings, Penistone

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TWO NEW Core blowers for bombs.

36" Cupola by Jackman.

50" Cupola by Jackman.

54" Cupola by Thwaites.

Morgan 250 lbs. Tilting Furnace Oilfired.

No. 1 August Sandmixer.

No. 2 August Type Mixer.

NEW PIT FURNACES 150 lbs. capacity, oil or coke fired. £35 each.

NEW SHOT BLAST CABINET PLANTS with motor driven Exhaust Fans, complete, all sizes. Prompt delivery.

ALEX. HAMMOND, *Foundry Machinery Merchants.*
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BUY FROM ME AND SAVE MONEY

MISCELLANEOUS—*Continued*

PATTERNS IN WOOD AND METAL for all branches of Engineering. Moulding methods carefully considered.—FURMSTON & LAWLOR, Letchworth.

PETER—WITH ONE EXCEPTION

With one exception Peter is an ordinary little fellow. Chubby, likeable, just five-and-a-half, full of life and fun and on occasions—be it admitted—of naughtiness.

Just now Peter's rather important, for this is his first term at school, and he's grappling with the intricacies of "A B C" and "Twice-Two": difficult subjects to all men of five-and-a-half, but even more difficult in Peter's case because—bad luck—he's totally blind. That's his One Exception

Peter learns reading, writing, and 'rithmetic through the medium of "Braille"—dull stuff compared with the coloured picture books of most five-and-a-halfs. However, he's a stout lad is Peter, and he's making great progress.

Would you like to know more about him? How, in spite of his "One Exception," he is being educated and, when older, technically trained and usefully employed.

There is a long waiting list of "Peters" throughout the British Isles, for whom training and accommodation must be provided in the immediate future.

Will you help with a donation or annual subscription? Any sum, large or small, will be gratefully received.

Here's a suggestion. Your eyesight is worth 3d. a year to you. Send Peter and his handicapped pals 3d. for every year you've had it. Now, please, in case it slips your memory. Good idea?

The Chairman,
SCHOOL FOR THE BLIND
(Founded 1838).
SWISS COTTAGE, LONDON, N.W.3

WE SHOT OR SAND-BLAST FOR ALL TRADES

Airless and Pressure Blast Cleaning Plants

AIR COMPRESSORS
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CHILLED IRON SHOT—BLASTYTE
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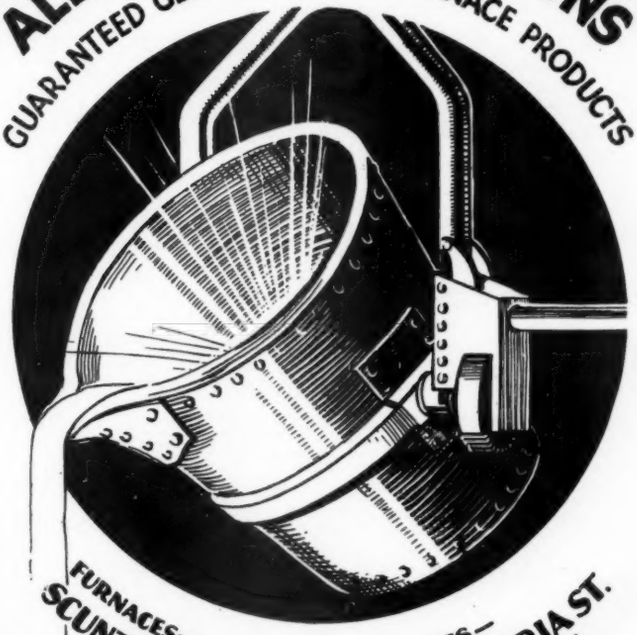
MIDHILL & GLENHILL ALLMINE SPECIAL PIGIRONS

GUARANTEED GENUINE BLAST FURNACE PRODUCTS



FURNACES— SCUNTHORPE LINCS.

SALES— 2 VICTORIA ST. LONDON·S·W·1

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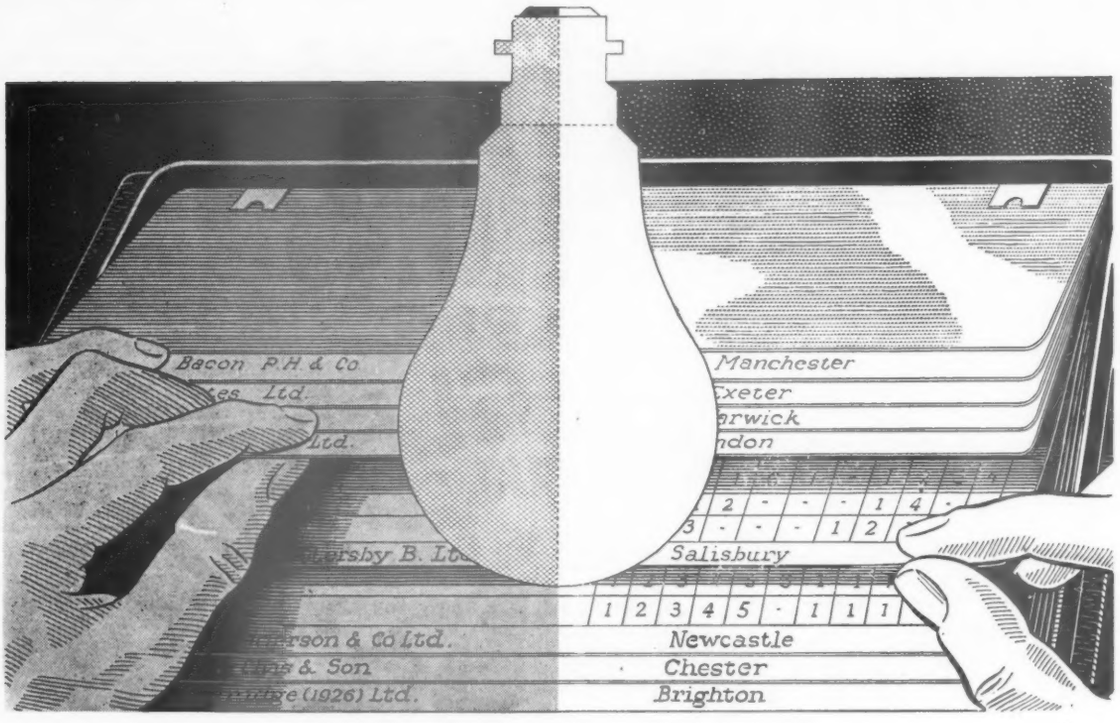
Light up—for efficiency!



There's no doubt about it—brighter lights mean faster, more accurate work, less spoilage and less fatigue. Light up then, with Osram Lamps. Their brilliance, their sturdiness, their reliability, will increase efficiency in every department of your business. With Osram Lamps you get what you pay for—your money's worth in light for every unit of current consumed.

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A G.E.C. PRODUCT

THE WONDERFUL LAMP

Advt. of The General Electric Co. Ltd., Magnet House, Kingsway, London, W.C.2

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COLBOND The Balanced Binder for Moulding sands for all purposes giving ideal green sand and dry sand strength.

COLBOND A fine grained colloidal clay having a high degree of plasticity and adhesiveness, very high refractoriness and possessing exceptional bonding properties.

COLBOND Used by the leading IRON and STEEL foundries for synthetic moulding sands, core sands, the renovation of spent sand, core washes and jointing pastes.

SILICA FLOUR A unique flour of crypto-crystalline or chalcedonic silica.

SILICA FLOUR Available in several grades of particle fineness, and used by the leading steel foundries for silica paints, core washes and mould dressings.

COLBOND AND SILICA FLOUR ARE BOTH EMPIRE PRODUCTS
AMPLE SUPPLIES ARE AVAILABLE

●

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HEATH ROAD, STAFFS. DARLASTON
FOUNDRY ENGINEERS, METALLURGICAL & ABRASIVE SUPPLIES
TELEPHONE: DARLASTON 356 TiB TELEGRAMS: BRADLEY 356

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A GOOD BOX SPEAKS FOR ITSELF

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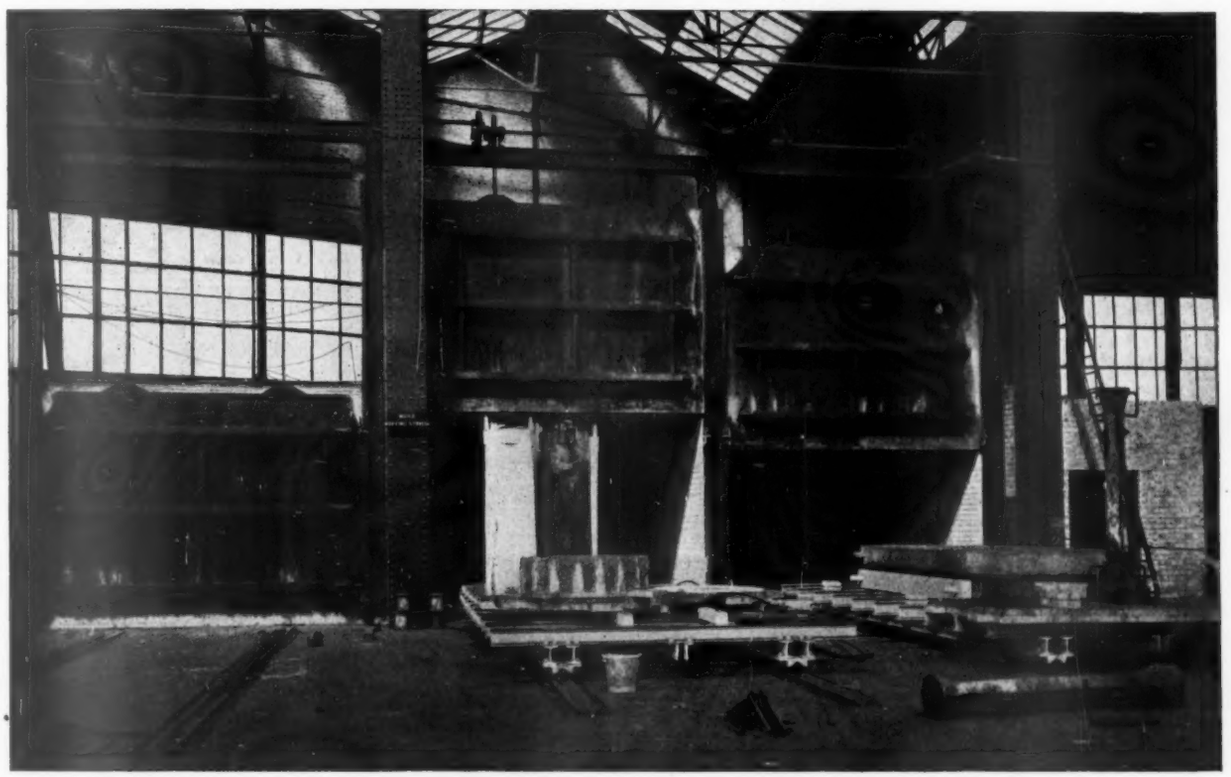
Pneulec drying stoves operate on the hot air pressure drying system, the chief advantages of which are ● uniform temperature in every position ● positive drying irrespective of weather conditions ● no burning, cracking or distortion ● clean, dry heat free from soot deposit ● quick drying ● complete temperature control in every stove ● satisfactory for every type of core and mould ● If you are interested, please ask for illustrated folder



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cupolas
Royer sand mixers
core and mould drying stoves
jarr rollover machines
sand preparing plants
sand mixing mills
sand disintegrators
rotary sand dryers
portable mould dryers

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FOR WORKING TO MACHINE SHOP TOLERANCES

Machine shops will not tolerate wide margins in castings.

STERNOCORE High Efficiency Core Oils, Creams and Compounds are great aids to working to these exacting standards.

For accurate cores, easier working, cleaner finish, reduced fettling, quicker drying, higher permeability, low and less objectionable gas evolution — and for lower true cost, stipulate . . .

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STERNOL LTD., FINSBURY SQUARE, LONDON, E.C.2.

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"TICYL"

The NEW

ALL-MINE LOW CARBON, LOW PHOSPHORUS

CYLINDER PIG IRON

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HATHERTON BLAST FURNACES,

BLOXWICH, STAFFORDSHIRE.

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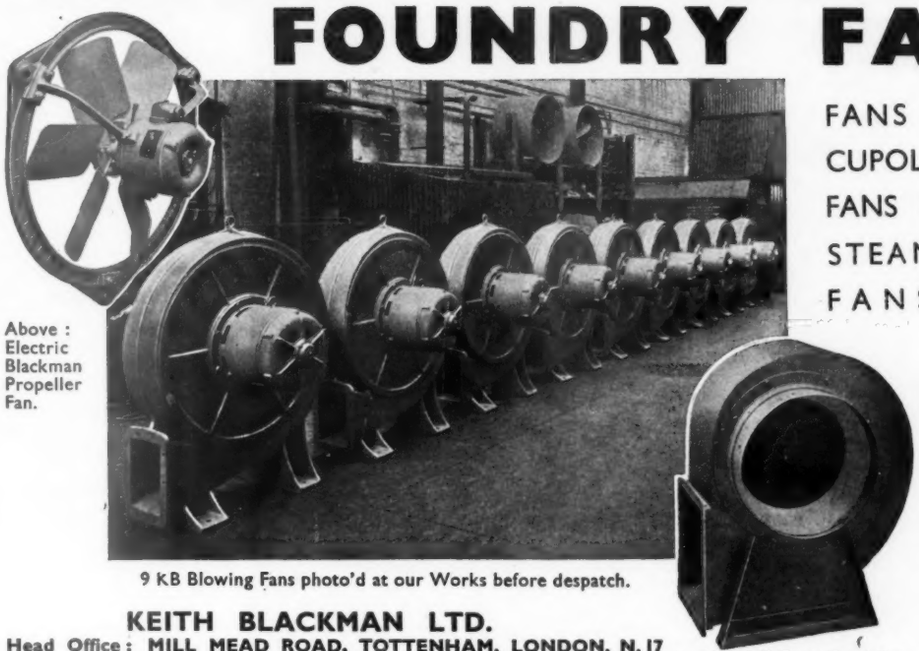
Keith Blackman

FOUNDRY FANS



Above : Electric Blackman Propeller Fan.

9 KB Blowing Fans photo'd at our Works before despatch.

FANS for VENTILATION
CUPOLA BLOWING FANS
FANS for DUST EXHAUST
STEAM REMOVAL FANS
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MECHANICAL DRAUGHT FANS
FANS for DRYING

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A "Keith" Centrifugal Fan.

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Fordath Engineering Co., Ltd.	—
Foundry & Engineering Co. (West Bromwich), Ltd.	—
Foundry Equipment, Ltd.	—
Foundry Plant & Machinery, Ltd.	17
Foundry Services, Ltd.	—
Fry's Metal Foundries, Ltd.	419
Gadd, Thos.	—
General Electric Co., Ltd., The	4
General Galvanizers, Ltd.	—
General Refractories, Ltd.	421
Gibbons, Bros., Ltd.	—
Gray, Thos. E., & Co., Ltd.	21
Green, George, & Co.	—
Guest, Keen Baldwins Iron & Steel Co., Ltd.	—
Hammond, Alex.	14
Harper, Wm., Son & Co. (Willenhall), Ltd.	20
Harrison & Son (Hanley), Ltd.	—
Hawkins, W. T., & Co.	—
Herbert, Alfred, Ltd.	—
Heywood, S. H., & Co., Ltd.	—
Hill-Jones, Thos., Ltd.	20
Imperial Chemical Industries, Ltd.	—
Incandescent Heat Co., Ltd.	—
International Alloys, Ltd.	2
International Furnace Equipment Co., Ltd.	—
Jackman, J. W., & Co., Ltd.	—
Jacks, William, & Co., Ltd.	13
Keith Blackman, Ltd.	9
King Bros. (Stourbridge), Ltd.	—
King, Taudevin & Gregson, Ltd.	—
Lafarge Aluminous Cement Co., Ltd.	—
Langley Alloys Ltd.	—
Lavino (London), Ltd.	—
Lempriere & Co. Pty. Ltd. O.T.	—
Lloyd, F. H., & Co., Ltd.	11
Lord, E. S., Ltd.	—
Luke & Spencer, Ltd.	—
Macnab & Co., Ltd.	—
Major, Robinson & Co., Ltd.	—
Mansfield Standard Sand Co., Ltd.	—
Marco Conveyor & Engineering Co., Ltd.	—
Mavor & Coulson Ltd.	—
Metropolitan-Vickers Electrical Co., Ltd.	—
Midland Monolithic Furnace Lining Co., Ltd., The	—
Mirrlees, Bickerton & Day, Ltd.	—
Mirrlees Watson Co., Ltd., The	—
Molineux Foundry Equipment, Ltd., W. J.	—
Mond Nickel Co., Ltd., The	1
National Savings Committee, The	—
Neild, G.	22
Norton Grinding Wheel Co., Ltd.	—
Notcutt, Walter P., Ltd.	—
Olsen, Wm., Ltd.	—
Parish, J., & Co.	—
Paterson Hughes Engineering Co., Ltd.	20
Pearson, E. J. & J., Ltd.	—
Pickerings, Ltd.	—
Pickford, Holland & Co., Ltd.	—
Pneulec, Ltd.	7
Portway, C., & Sons	—
Precision Presswork Co., Ltd.	—
Price, J. T., & Co., Ltd.	—
Rapid Magnetting Machine Co., Ltd.	—
Reavell & Co., Ltd.	—
Richardson, R. J., & Son, Ltd.	—
Ridsdale & Co., Ltd.	—
Riley Stoker Co., Ltd.	—
Robson Refractories, Ltd.	1
Roper, E. A., & Co.	22
Rowland, F. E., & Co., Ltd.	—
Rustless Iron Co., Ltd., The	15
St. George's Engineers, Ltd.	15
Safety Products, Ltd.	—
Sheepbridge Coal & Iron Co., Ltd.	—
Siemens Electric Lamps & Supplies, Ltd.	—
Smith, Albert, & Co.	—
Smooth-On Mfg. Co.	—
Spermolin, Ltd.	—
Stanton Ironworks Co., Ltd., The	417
Staveley Coal & Iron Co., Ltd.	—
Steel, John	22
Steele & Cowlishaw	—
Stein & Atkinson, Ltd.	—
Stein, J. G., & Co., Ltd.	—
Sterling Foundry Specialties, Ltd.	6
Sternol, Ltd.	8
Stewarts and Lloyds, Ltd.	—
Teisen, Th.	—
Thermic Equipment & Engg. Co., Ltd.	—
Thomas, G. & R., Ltd.	8
Tilghman's Air Compressor Co.	—
Tilghman's Patent Sand Blast Co., Ltd.	23
United Steel Companies, Ltd., The	—
Universal System of Machine Moulding & Machinery Co., Ltd.	—
Vaughan Jones & Co.	—
Vickers-Armstrongs, Ltd.	—
Walker, I. & I.	24
Ward, Thos. W., Ltd.	1, 14 & 18
Waring Bros.	—
Warner & Co., Ltd.	—
Watson's (Metallurgists), Ltd.	22
Webster & Co. (Sheffield) Ltd.	—
Wengers, Ltd.	—
West Midland Refining Co., Ltd.	—
Wilkinson, Thos., & Co., Ltd.	—
Woodward Bros. & Copelin, Ltd.	—
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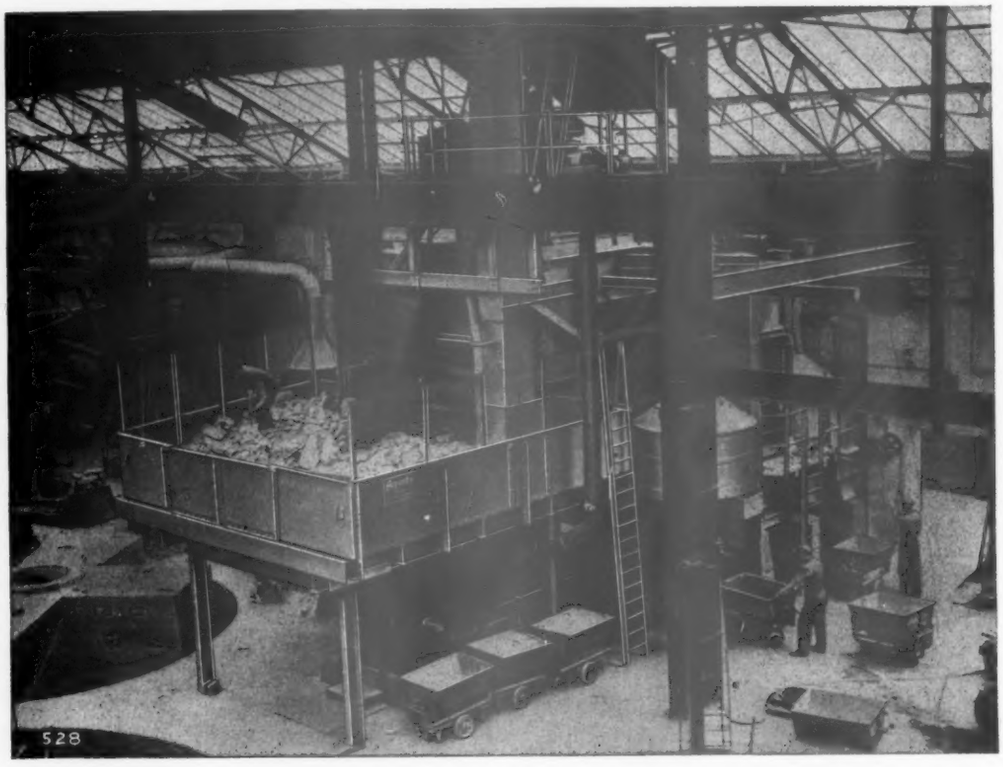

An August's Sand Reclamation and Preparation Plant for the Randupson Process.

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